**ROYAL AERONAUTICAL SOCIETY**
**FLIGHT OPERATIONS GROUP**
**SPECIALIST DOCUMENT**

# SO YOU WANT TO BE A CAPTAIN?

## COMMAND COURSE TRAINING MODULE

## Authors

**Captain Ralph KOHN, FRAeS**
**Captain Christopher N. WHITE, FRAeS**

## OUT OF THE FOG

# INTRODUCTION

**A**
**GUILD OF AIR PILOTS AND AIR NAVIGATORS**
**AND**
**ROYAL AERONAUTICAL SOCIETY**
**FLIGHT OPERATIONS GROUP**
**SPECIALIST DOCUMENT**

This Specialist Document is intended to be an instruction manual to be used in preparation for, then during a command course. The whole is a reference manual to be read and studied at home, or as part of a course. It is intended to give prospective captains more background to add to their experiences as first officers. Some material has been included as a refresher and as an offering on how best to apply everyday procedures, such as entering and then flying holding patterns inter alia. It is not really meant to be referred to en-route as it were. Some excerpts, such as the useful shortcuts and ideas items offered in Appendix A, might be copied by readers for reference; but the whole SD is not aimed for carrying in briefcases.



The intent of this compilation is to make it self-sufficient, so as not to have to go to other documents for information. However, 'Source' documents should be consulted for their amendment status. The content as offered makes this manual a one-stop source of relevant data that should be of interest to a captain-to-be.

At the time of going to press European Flight Operations are governed by EU-OPS but the European Community has decided that from April 2012 both Flight Operations and Flight Crew Licensing regulation will become the responsibility of the European Aviation Safety Agency (EASA). EASA has already produced draft requirements which are currently under consultation with industry, together with other stakeholders and expects to promulgate these during 2010. EASA Regulations are based largely on EU-OPS, now that JAR-FCL is no longer in force.

From April 2012 a new set of regulations come into force being 'EASA-OPS'. In most areas there will be little or no change from EU OPS. However, EASA OPS applies to all professional flying including Business Jet Operations and the operations of Professional Aviation Training Organisations. For example FTL schemes are required for this category of operators. The same thing applies to FCL matters.

**ROYAL AERONAUTICAL SOCIETY**

***At the forefront of change***

Founded in 1866 to further the science of aeronautics, the Royal Aeronautical Society has been at the forefront of developments in aerospace ever since. Today the Society performs three primary roles:

- To support and maintain the highest standards for professionalism in all aerospace disciplines;
- To provide a unique source of specialist information and a central forum for the exchange of ideas;
- To exert influence in the interests of aerospace in both the public and industrial arenas.

***Benefits***

- Membership grades for professionals and enthusiasts alike
- Over 17,000 members in more than 100 countries
- 175 Corporate Partners
- Over 100 Branches across the world
- Dedicated Careers Centre
- Publisher of three monthly magazines
- Comprehensive lecture and conference programme
- One of the most extensive aerospace libraries in the world, the National Aerospace Library in Farnborough.

The Society is the home for all aerospace professionals, whether they are engineers, doctors, air crew, air traffic controllers, lawyers, to name but a few. There is a grade of membership for everyone - from enthusiasts to captains of industry.

To join the Society please contact *Membership*, Royal Aeronautical Society, No.4 Hamilton Place, London W1J 78Q, UK - Tel: +44 (0)20 7670 4300; Fax: +44 (0)20 7670 4309. e-mail: raes@aerosociety.com & website: www.aerosociety.com

The Royal Aeronautical Society has 24 Specialist Group Committees, each of which has been set up to represent the Society in all aspects of the aerospace world. These committees vary in size and activity, but all their members contribute an active knowledge and enthusiasm. The Groups meet four or five times a year and their main activities centre on the production of conferences and lectures, with which the Society fulfils a large part of its objectives in education and the dissemination of technical information.

In addition to planning these conferences and lectures, the Groups also act as focal points for the information enquiries and requests received by the Society. The Groups therefore form a vital interface between the Society and the world at large, reflecting every aspect of the Society's diverse and unique membership.

By using the mechanism of the Groups, the Society covers the interests of operators and manufacturers, military and civil aviators, commercial and research organisations, regulatory and administrative bodies, engineers and doctors, designers and distributors, company directors and students, and every other group of professionals who work within aerospace.

**GUILD OF AIR PILOTS AND NAVIGATORS**

***A Guild of the City of London***

Founded in 1929, the Guild is a Livery Company of the City of London, receiving its Letters Patent in 1956.

With as Patron His Royal Highness The Prince Philip, Duke of Edinburgh, KG KT and as Grand Master His Royal Highness The Prince Andrew, Duke of York, CVO ADC, the Guild is a charitable organisation that is unique amongst City Livery Companies in having active regional committees in Australia, Canada, Hong Kong and New Zealand.

***Main objectives***

- To establish and maintain the highest standards of air safety through the promotion of good airmanship among air pilots and air navigators.
- To constitute a body of experienced airmen available for advice and consultation and to facilitate the exchange of information.
- To raise the standard knowledge of airmen.
- To make awards for meritorious achievement and to issue Master Air Pilot and Master Air Navigator Certificates.
- To assist air pilots and air navigators and their dependents with their children's education and those in need through a Benevolent Fund.

The first concern of the Guild is to sponsor and encourage action and activities designed to ensure that aircraft wherever they may be, are piloted and navigated by highly competent, self reliant, dependable and respected people. The Guild has therefore fostered the sound educational and training of air pilots and air navigators, from the initial training of the young pilot to the specialist training of the more mature. It rewards those who have reached the top of their profession through long years of experience and accomplishment and those who, by their outstanding achievement, have added to the lustre of their calling.

The majority of Guild members are or have been professional licence holders, both military and civil, but many are also private pilot licence holders. Guild members operate not only aircraft in airlines and all the branches of Her Majesty's armed forces but also in every area of general aviation and sporting flying.

The aircraft considered, range from supersonic military and civil, through single and multi-engine fixed-wing and helicopters, training aircraft, microlights, gliders and balloons, to experimental aircraft. This is, for many members, the particular strength and attraction of the Guild, with its diverse spread of interests together with an entirely non-political outlook, forbidding any trade union activities.

To join the Guild, please contact the Clerk, Guild of Air Pilots and Air Navigators, Cobham House, 9 Warwick Court, Gray's Inn, London WC1R 5DJ -Tel: +44 (0)20 7404 4032; Fax: +44 (0)20 7404 4035. E-mail: gapan@ gapan.org & website: www.gapan.org

**This specialist document represents the views of the Flight Operations Group of the Royal Aeronautical Society. It has not been discussed beyond the Learned Society Board and hence it does not represent the views of the Society as a whole.**

# SO YOU WANT TO BE A CAPTAIN?

**by**

**Captain Ralph Kohn, FRAeS**
**&**
**Captain Christopher N. White, FRAeS**

## THE REASON WHY?

While running numerous Command Courses for various airlines, two questions repeatedly cropped-up from the candidates. The first one was: "How do we obtain experience and where can we find the information that we need to be a good Captain?" Yes, there are references scattered in many books and legal documents if, that is, you can actually find the book or document. Because of this, a large number of candidates came ill prepared because they had not been fortunate enough to fly with captains who were ready to impart their knowledge. In my case as a junior first officer on a long haul fleet, I once asked a simple question which was perplexing me, the reply to which was "I am not here to train you, go and find out". *Thank you …* that really answers the question! The next regular question from candidates was "When should one start preparing for command?" The answer is simple. After an ab-initio pilot has completed six months on type with his/her first airline and understands both the aircraft and the mode of operation … that is the time to start preparing to be a captain.

With this in mind, I approached my long time friend and colleague Captain Ralph Kohn, FRAeS, who has a lifetime of experience in Civil Aviation as a Captain, instructor and as a Regulatory Authority examiner of airmen. We put our heads together to produce such a document and that is how **"*So You Want to Be a Captain?*"** was born. We have endeavoured to include a summary of as much information as possible on the law and management techniques as these affect captains. We have also included other people's experiences, operational tips and some forgotten facts. By so doing, we reduced the need for cross-reference to other sources of information, so that when using this guide on a command course, all the information would be readily accessible. With this guidance, it is sincerely hoped that co-pilots can start on a properly defined path to help their personal development as captains-to-be and become good, thinking, considerate and effectively efficient Aircraft Commanders.

**Readers will find that some information appears in more than one place. This is intentional for ease of rapid reference, making it unnecessary to look for it elsewhere to refresh memory, so not breaking the reading flow.**

The objective of a Command course is to prepare co-pilots for the transition from the right hand seat as a follower, monitoring in a supporting role, to move over to the left hand seat as a confident Captain; who efficiently leads the team that gets an aircraft to its destination safely, as the Company's front-line representative. A word of caution would not come amiss at this point. Too much confidence may be misinterpreted as arrogance, so think about that and act accordingly.

Enjoy the opportunity to become a really good Aircraft Commander but above all, when you do become a Captain, be understanding towards the people around you. It makes life easier and much safer.

Captain Christopher N. White, FRAeS

Captain Ralph Kohn, FRAeS

**The operator of any particular aircraft type will have a preferred Standard Operating Procedure (SOP) for managing approaches (and other phases of flight) so as to ensure standardisation across all the crews. In such cases, company SOPs have primacy and this publication should be seen as indicative rather than prescriptive.**

**COMMAND COURSE TRAINING MODULE**

**Table of Contents**



**INDEX OF APPENDICES**



***The Appendices must be read in conjunction with the Main Paper. They are complementary corollaries and an important part of this Specialist Document***

**IMPORTANT**

**Please note that ALL references made to *Men 'pilots in command'* in this Guide, equally apply to l*ady 'pilots in command'.* Hence, where *He, Him* and *His* are mentioned, read it to also mean *She, Her* and *Hers;* respectively he/she, him/her or his /hers.**

**Published by**
**The Royal Aeronautical Society**

**In conjunction with**
**The Guild of Air Pilots & Air Navigators**
**London**

## The Authors

**Captain Ralph KOHN, FRAeS**

*Born in Alexandria, Egypt, Ralph Kohn was educated at Victoria College (Alexandria) and at Nottingham. He majored in Textiles prior to a career in aviation. Learning to fly in 1950 whilst still at college, he served with the RAFVR then obtained his commercial pilot licence in 1953. He was an aero-club instructor before joining Eagle Aviation as a First Officer in 1955.*

*In 1960 he gained his first command on Vikings, staying with the company as it changed name until Eagle Airways ceased operations in 1968. After a short spell with Dan Air, he joined the British Aircraft Corporation as a training captain, and then moved to the UK CAA Flight Operations Inspectorate in 1971.*

*After retiring from the CAA as a senior flight operations and training inspector in 1991, he went on to help the Bermuda DCA as a principal inspector of flight operations during the setting up of the necessary regulatory infrastructure to satisfy ICAO, UK CAA and FAA norms for the supervision of aircraft operations within the Bermuda Aircraft Register jurisdiction. Other 'overseas' Regulatory Authorities were also helped on a consultancy basis to achieve a similar status.*

*Ralph has flown some 16,500 hours of which over 11,000 were in command of such aircraft as the Vickers Viking, DC-6A/B, Vickers Viscount, Bristol Britannia 300s, all the BAC 1-11 variants, Boeing 707-100/300/720 and Boeing 747-100/200/400 series aircraft, not to mention a variety of smaller aeroplanes like the HS 125, Beagle 205, Beech 90, DH Dove, DH Heron, Airspeed Oxford and Consul, DHC Chipmunk, Percival Proctor, DH 82A Tiger Moth and various Austers, instructing on many of these. The totals mentioned above do not include countless hours spent on classroom instruction, the few thousand hours spent in simulators instructing or examining on a variety of jet aircraft, or the many hours spent on flight inspections and checking / testing simulators, over the past 30 years.*

*His experience ranges from* ab-initio *instructing, to teaching pilots on conversion to a new aircraft type in an airline training environment. He was a flight operations and training inspector (TRE/IRE on Boeing 747 and 707 aircraft) with the UK CAA. His many duties included CAA Flying Unit initial instruction of trainee Instrument Rating and Type Rating examiners at Stansted, where airline pilots underwent training and testing to achieve Authorised Examiner status.*

*A Fellow of the Royal Aeronautical Society, Captain Kohn is a founder member of The Society's Flight Operations Group and was its chairman from 2003 to 2006. He is a Liveryman of the Guild of Air Pilots and Air Navigators. He was awarded the Guild's Master Air Pilot Certificate in 1978 and is also a participating consultant on the Education and Training Committee of that Guild.*

**Captain Christopher 'Chris' N. WHITE, FRAeS**

*Born in Cairo Egypt, Chris White was the eldest son of a British Army Officer. Educated at Ampleforth College near York, he became a Senior Under Officer in the CCF Air Cadets. While in the cadets he obtained a Flying Scholarship from the RAF, followed by a PPL.*

*He was the first ever* ab-initio *cadet sponsored by British United Airways (BUA), trained at AST Perth, Scotland in 1962-3. He was made redundant in the big redundancy period of 1963 but managed to acquire a summer job with Jersey Airlines, where he flew Herons. This was converted to a permanent contract at the end of the summer and he flew Dakotas, Heralds and Viscount 708/736/833s for Jersey Airlines.*

*He left after four years to join BOAC on the B707 flight as a first officer, also obtaining a Flight Navigator's licence which was a Company requirement in those days. Posted to the B747/100 fleet at the start of operations in 1971. Went to the VC10 for command after eight years in the company, returned to the B747 fleet 9 months later as a captain, subsequently becoming an IRE/TRE. Joined the B747/400 fleet as one of the nuclei instructors when the 400 fleet was first formed, later becoming an Aircraft Base Training Captain and was checked-out by Captain Ralph Kohn. Retired from British Airways after 30 years.*

*Chris has flown 19,000 hours, of which 14,000 hours are in command as well as some 4,000 hours instructing in simulators. He has a total of 14,000 hours on B747s.*

*He set up an air taxi operation which grew into a successful freight operation. He has flown a large number of light singles and twins, as well as owning two light aircraft, one of which he has flown extensively throughout the UK, Ireland and Europe.*

*After retirement from British Airways he became a consultant, working for various FTO's, training cadets for airlines, including British Airways JOC cadets. He became a CAA IRE/TRE Core Course instructor and examiner, training the Training Captains for most UK, European, Middle Eastern, African and Far Eastern airlines. He then moved to The Netherlands to develop the Airline Jet Foundation Course for European Pilot Selection & Training (EPST). This is a highly innovative Dutch company, which selects, sponsors and trains some 60* ab-initio *cadets a year for placement with major UK and European airlines. While working with EPST he became a director of the company and was asked by Kuwait to train the trainers of The Kuwaiti Emiri flight (Royal Flight).*

*Now fully retired, he is a Fellow of the Royal Aeronautical Society and sits as a member of the Fight Operations Group.*

**The Royal Aeronautical Society**
**Flight Operations Group**

The Flight Operations Group committee consists of 41 members and ten Consultants from both the civilian airline and military transport & flying training sectors, with Flight Safety and the Quality of Training throughout the Public Transport Industry being its primary objectives. The FOG is a discussion group that focuses on issues which primarily concern civil aviation, although it touches upon aviation safety in the armed forces, specifically where the safety issues could also be applicable to civilian operations. Its membership is highly respected within the civil aviation operations area and brings together a team with many years of experience in the field of aviation.

**RAeS Photo**

Capt Maurice Knowles (CTC)/(Chairman), Capt Peter D.J. Terry (Alpha Aviation Academy)/(Vice chairman), Flt Lt Philip Kemp RAF (Secretary),
Dr Kathy H. Abbott (FAA), Dr John C. Barnett, Capt Nils Bartling (Hapag-Lloyd), Capt Terence 'Terry' J. Buckland JP (CAA), Capt F. Chapman (Airbus Test Pilot), Capt Ian Cheese (FlyBe), Capt John M Cox (Safe Ops Sys Inc), Capt Hugh P.K. Dibley (Airbus Consultant), Capt Robin Evans (Jet2.com), SFO Linton Foat (Thomas Cook Airlines), Laurent J. Ghibaut, Sqn Ldr Nick Goodwyn RAF, Mark P. Green (NATS), Capt Richard 'Dick' K.J. Hadlow, Capt John C. Hutchinson, Air Cdre Richard Jones CBE (UKSFC), Capt Ralph Kohn, Capt Simon J. Lawrence (Emirates Airlines), Capt Paul D. Lightbody (Virgin Atlantic), Capt Seamus J.P. Lyttle, Tim J. MacKay (GATCO), Capt David A.J. Martin, Capt Anthony 'Mac' C. McLauchlan, Peter Moxham, Matthew Moxon (RAeS YMB), Capt David Owens (Airbus Test Pilot), Kim O'Neil, Capt Dhamseth Pallawela (Emitates Airlines), Capt Anthony Petteford (Oxford Aviation Academy), SEO Peter G. Richards, Sqn Ldr Adam W. Robinson RAF, Sqn Ldr Nigel 'Nige' R. Scopes RAF, Capt Christopher 'Flip' Seal (FlyBe), Capt Tim H. Sindall, Capt Philip 'Phil' H.S. Smith, Capt David H. Thomas (FTE Jerez), Capt Richard M.H. Weeks (NetJets), Capt Christopher 'Chris' N. White.

**Participating Consultants**
Peter P. Baker (Test Pilot), Dr Mary P. Baxter (FAA), Dr Simon A. Bennett (University of Leicester), Dr Barbara K. Burian (NASA), Capt J.H. Casey (Safe Ops Sys Inc), Capt Gerry L. Fretz, Capt Ronald 'Ron' Macdonald, Capt David Pelchen (Sky Europe Airlines), Capt Robert 'Bob' A.C. Scott, Capt David R. Smith (Alaska Airlines)


**The following Specialist Documents are joint RAeS Flight Operations Group and GAPAN publications**

***The Future Flight Deck* (1992 - 93)** by Captain Peter Buggé, FRAeS & Capt John Robinson, AFC, FRAeS
***British Aviation Training* (1998)** by Captain G.L. Fretz, FRAeS
***Smoke and Fire Drills* (1999)** by Captain Peter Buggé, FRAeS, Captain Ron Macdonald, FRAeS and SEO Peter Richards. IEng, FRAeS
***So You Want to be A Pilot?* (2002)** by Captain Ralph Kohn, FRAeS
***The Human Element in Airline Training* (September 2003)** by Captain Ralph Kohn, FRAeS
***So You Want to be A Pilot?* (2006)** by Captain Ralph Kohn, FRAeS
***Reducing the Risk of Smoke, Fire & Fumes in Transport Aircraft* (January 2007)** by Captain John M. Cox, FRAeS
***So You Want to be A Pilot?* (2009)** by Captain Ralph Kohn, FRAeS
***Aeroplane Upset Recover Training*** (**October 2010**) by Captain John M. Cox, FRAeS

The listed Documents represent the views of the Specialist Flight Operations Group of the Society and of the Guild committee that were involved with their preparation. They were not discussed outside the Specialist Group Committee or the Guild's Secretariat. As such, they do not necessarily represent the views of the Society or the Guild as a whole, or any other specialist Group or Committee or of the Civil Aviation Authority (the UK National Aviation Regulatory body).

**ACKNOWLEDGEMENTS**

The Authors wish to thank all those who helped to produce this Specialist Document.

Furthermore, (again alphabetically), we are grateful to Airbus, Boeing, British Airways, the UK Civil Aviation Authority (CAA), the United States Federal Aviation Administration (FAA), the Flight Safety Foundation (FSF), NASA and United Airlines for Examples and Source Material.

The Royal Aeronautical Society Flight Operations Group Documents Publication sub-group, that is (again alphabetically), Dr Barbara Burian, PhD, FRAeS, Captain Richard 'Dick' K.J. Hadlow, FRAeS, Captain Ralph Kohn, FRAeS, Captain Ronald Macdonald, FRAeS, Captain David Martin, FRAeS, Peter Moxham, FRAeS, SEO Peter Richards, IEng, FRAeS, Captain Philip 'Phil' H.S. Smith, MRAeS and Captain Christopher 'Chris' N. White, FRAeS, contributed to the Document and its Appendices, helped to proof read the whole and saw to the timely publication of this Specialist Document.

FOG photo

FOG Publications Editorial team
Peter Moxham, Peter Richards, David Martin, Ron Macdonald, Seamus Lyttle
Phil Smith, Ralph Kohn, Chris White, Dick Hadlow
(Not in picture: Maurice Knowles, Peter Terry and John Barnett)

The following organisations need to be thanked as Sources of information:

1. The charting product of Navtech Inc producers of "Aerad Flight Guides and Supplements, containing airport data and instrument approach let-down plates"; and

2. The North American Jeppesen Inc, Flight Guide providers. Jeppesen is headquartered in Englewood, Colorado and has offices located around the world. Jeppesen is a subsidiary of Boeing Commercial Aviation Services, a unit of Boeing Commercial Airplanes.

Our appreciation must also be recorded for the individual and most valuable contributions from: Captain Robin Acton (British Airways Ret), Dr John Barnett, CEng, FIEE, FIRSE, ARAeS, Captain Nils Bartling, MRAeS (Hapag-Lloyd), SFO Linton Foat, AMRAeS (Thomas Cook Airlines), Captain Phil A.F. Hogge, FRAeS (British Airways Ret), SFO Peter Kohn British Airways (A320-LHR), Captain A.C. 'Mac' McLauchlan, FRAeS (British Airways Ret), SEO Peter Richards, FRAeS (British Airways Ret), who spent much time proof-reading and also contributed practical technical advice from his former operational flight engineering career, Captain R.A.C. 'Bob' Scott, FRAeS (Cathay Pacific Ret), Captain Tim Sindall, FRAeS (CAA Ret), Captain Philip 'Phil' H.S. Smith, MRAeS (British Airways Ret), and last but not least, Captain Paul Wilson, FRAeS.

A particular thank you to Captain 'Phil' Smith must be recorded. The document would have been the poorer without his able redrafting of illustrations in many of the Parts and the pictures he provided, combined with his meticulous proof-reading contribution.

Finally, we are most grateful to Philip Shepherd QC for his paper on *The Legal Responsibilities of an Aircraft Captain, according to UK Air Law,* as it stood, until EASA OPS 1 came into being. His words on the subject may be found in Part 2 at Section 4 as background and to serve as an introduction to the subject. Philip Shepherd is a Queen's Counsel and a specialist in Aviation Law matters.

**Philip Shepherd QC**


XXIV OLD BUILDINGS
LINCOLN'S INN
LONDON
September 2007

Philip Shepherd is a commercial barrister concentrating on business disputes, usually with an international element. He has specialised in aviation law since 1985 covering insurance, product liability, finance and leasing, EC competition and regulation, air accidents, carriage by air, arrest of aircraft, CAA and regulatory issues, aircraft sales and purchase transactions.

Long recommended by Legal 500 and Chambers & Partners in this area, Philip has acted as counsel in nearly all the significant aviation and travel cases in recent years including:

- **Sunrock Aircraft Corporation v SAS** (2007) EWCA Civ 882: The defendant airline was responsible under its lease with the claimant for the diminution in value of the life-limited parts of an aircraft's engine and for two scab patches that had occurred on the fuselage. There was no good reason for the defendant to renege on an agreement to refer the dispute to an independent consultant.
- **Ryan Air v SR Technics (2006):** £12m case for Ryanair against SR Technics, the former maintenance arm of Swissair, who managed to cause serious damage to 10 Ryanair aircraft. They used the wrong tools when scraping out sealant before re-painting, thereby damaging large parts of the airframe. Some aircraft are complete write-offs.
- **Bristow Helicopters Ltd v Sikorsky Aircraft Corporation** and 46 0thers 2004 EWHC 401 (Comm) Claim for declaration by carrier against passenger and crew dependants of 11 persons killed in helicopter accident preventing them from suing in the USA - an entirely legitimate tool to fix the timing and venue of potential trans-national litigation

He also acts as counsel and arbitrator in commercial arbitrations and has extensive experience in domestic and International arbitration. He is an accredited mediator.

Philip is a member of the Commercial Bar Association, the European Circuit, the European Air Law Association, the International Bar Association, the Chartered Institute of Arbitrators, the Lawyers Flying Association and the Royal Aeronautical Society.

**END OF INTRODUCTION**

# PART 1 - HISTORICAL

**CONTENTS**



## 1. SO YOU WANT TO BE A CAPTAIN ?

by Captain Ralph Kohn, FRAeS - (Flight Operations Group)

This Specialist Document has been written specially for those who are about to start a Command course. It is hoped that it may go some way in helping those who are about to be promoted, to explore the new world of command on which they are about to embark. Following this Introductory Part 1, the Legal aspects of Command are discussed in Part 2. Part 3 covers a number of subjects under the heading ***In Command at all times***, because co-pilots have few opportunities to observe situations when things go wrong on aircraft, due to the great reliability of today's aeroplanes and their engines. Part 4 was developed to offer *'Situations'* and how these are resolved by 'the captain', with comments and thoughts for the reader to ponder over, where decisions made were not of the best. It also contains a collection of articles describing real situations contributors have experienced. It is hoped that the reader may learn something from the comments appended to each story. The articles show good command decisions and illustrate poor ones, indeed downright bad ones; to complement the 'experience luggage' gained over the years in the right hand seat, quietly observing how the other pilot handles himself and situations. Having seen the good, the indecisive and the bad, it is felt that, as discussed in Part 3, the reader will have already built a mental picture of how he intends to function in the role of Captain for the rest of his career in the airlines, well before his selection for promotion. It is hoped that this Part will be useful to the prospective captain before and whilst he is on his command course.

### 1.1 WORKING WITH OTHERS

An aircraft approaching a 'Departure' from the terminal is under numerous and sometimes conflicting pressures and it will need calm and focused approach by the Commander to 'field' them all. The technical state of serviceability is determined by licensed engineers, who will know an immense amount more about the aircraft than you will. Therefore, you have to accept on trust what they tell you and what they have written in the Technical Log Book. However, if you have any doubts or misgivings, maybe even only feelings of discomfort about a situation or a technical condition, then you should always ask for clarification. A handy aphorism is 'Pause for Thought' because the bottom line of your command is Safety. Insist that any given explanation is on 'your wavelength', not techno-babble and, where you are departing with 'deferred defects', that both pilots understand all the resulting ramifications and limitations.

### 1.2 ON MINIMUM EQUIPMENT LISTS AND FLIGHT WITH INOPERATIVE COMPONENTS

Remember that the Minimum Equipment List (MEL) is, at best, a guidance document to be used in the decision making process. It is not to be taken as an excuse to keep going regardless of any misgivings, particularly when operating from the aircraft's main operational and maintenance base from which aircraft should be dispatched with a clean technical log and no carried forward defects. The MEL is a useful tool to allow the recovery of an aircraft with a malfunctioning system, from an outstation to a place where it can be rectified. In the final analysis, the Captain has the last word on whether to accept continued operation with a deferred defect in accordance with MEL guidance, or not. Defects that remain in the technical log for prolonged periods, or repetitive reports of malfunctions in the immediate-past history of the aircraft's technical state, must be considered in relation to the risk of continuing operating with such defects, when deciding whether to accept MEL guidance or not. The last word rests with the aircraft commander. Captain, that means YOU!

Coupled with this possible dilemma, the Dispatcher will be doing all possible to keep to schedule and will thrust the Load Sheet into your hand, pleading to just 'sign and be gone'. Computer generated they may be these days, but the inputs are made by humans and it is all too easy on a dark and dirty night to make a mistake, especially with over-tired ground handling staff. You may/will be dealing with enormous weights and trim dimensions and a competent grasp of the fundamentals is essential. So if your dispatch is complicated by icing conditions, late/missing baggage or cargo, catering or special passenger needs, there will be a compelling pressure from outside to get you away. However, for you the Commander, the over-arching 'safety first' intent must prevail, to keep you where you are until you are satisfied it is safe to go.

### 1.3 ON THOSE AROUND YOU

Be considerate to all who you deal with in your daily operational life, like flight dispatchers, engineers, traffic officers and all the others who are involved with your departure. Be particularly considerate towards your flight crew. This includes the cabin staff. Bring them all into your decision making process. Do not let command go to your head. It takes a lot of people to get you into the air with a load of passengers or freight to deliver to your destination of the day. All must be treated as you would expect them to treat you. You are but one, though very important cog in the operation of an aircraft, on whose shoulders rests the ultimate safety of the flight; so deal with people around you with the respect that their disciplines deserve but gently keep an eye open for potential errors. They are only human. This means that you must cross-check what is offered to you for signature, be it a technical log or the load sheet. Gross error checks must become part of your modus operandi as a fall back to ensure that errors will not kill you, so develop your skills in doing them (see Part 2).

### 1.4 ON PROMOTION TO COMMAND AND OTHER ADDITIONAL RESPONSIBILITIES

Shy away from turning into a bully, especially if you move to training, instructing and examining. Maintain a calm, balanced, constructive approach and do the job with neither fear nor favour. Always stand firm but remain fair. Remember to take good care of your team, for at the end of the day, you are a team leader that others look to for advice, guidance and their Safety. Let that be your primary thought at all times.

ENJOY your flying and fly PROFESSIONALLY, appreciate your crew and every day of your precious command.

## 2. HISTORICAL BACKGROUND

### 2.1 THE POST WORLD WAR 2 AIRLINES SCENE IN THE UK

**These historical points are included, as the participant flight crews rapidly gained immense levels of airmanship and Command competences. Many of the editorial team for this paper were young co-pilots when this was going on. Command styles evolved in fractured bursts and coloured the thoughts of most of us.**

The pre-war Imperial Airways maintained a long haul presence throughout the war, operating as BOAC from 1939 throughout World War 2 on continuous operations. Its crews (some seconded from the RAF), flew Short C-Class flying-boats and converted Liberator bombers to various parts of Neutral Europe (such as Lisbon in Portugal), the Middle East to India and also to the United States across the North Atlantic using three Boeing 314 flying-boats inter alia. The route from England to Australia ended with the closure of the Mediterranean in 1940 and the flying boats moved operations to Durban, flying from there to Australia via Cairo, India and Malaya. This was famously known as the ‘Horseshoe Route’. Luxury fittings were forfeited to increase the passenger capacity up to twenty-nine. The subsequent invasion of Malaya meant that some flying boats were left cut-off in Australia, unable to return to the continent during the war with Japan. Many of these aircraft were lost.

The Southampton flying boat base became part of BOAC. This company was to operate long-haul flights and one of the first things that the new company implemented, was moving the flying boat operations from Southampton to Poole in Dorset. It had become too dangerous to remain in Southampton, whose strategic importance made the city a high bombing risk. They were not to return until 1947. From Poole, a service was maintained to Foynes in Ireland, the starting point for flights across the Atlantic to America. In 1941, operations from Poole were getting flights through to Cairo and Lagos via Lisbon. The Japanese had managed to cut the India-Australia service, but in 1943, a number of military flying boats were converted by BOAC for civilian use and the Poole to Cairo and Karachi service resumed, as did the route to Calcutta in 1944; then to Singapore and Sydney in 1946.

In the aftermath of World War 2, when Europe was in the throes of recovery from the devastation caused by this most destructive of wars, there developed a particular need to provide Germany in general and Berlin in particular with the means to survive, after it was blockaded by the Russians. The Air Forces of the Western Nations that had allied to fight the Nazi regime of oppression, had to provide the means of transporting food, coal and other life sustaining commodities, to feed and keep alive the civilian population trapped in the part of Germany isolated behind the Russian ‘cold front’. In April 1948, the United States Air Force began to use transports like the C-47 (military Douglas DC-3) and C-54 (Douglas DC-4) to supply occupied Berlin. At the same time, the RAF flew Short Sunderlands, Douglas DC-3 (Dakotas), HP Hastings and Avro Yorks in support of that operation. That operation developed into the intensive Berlin Airlift that started on 27 July 1948. This was where the competence of flying in a ‘Holding Pattern’ first appeared. (See Leon Uris’ book *Armageddon*).

These Military transports were assisted in this effort to keep Berlin supplied with food and other necessities by the British Overseas Airways Corporation (BOAC) with their ‘Hythe’ flying boats, Liberators and Lancastrians and also by British European Airways (BEA). BEA co-ordinated the civil airlines’ movements and flew Vikings and Dakotas in support of the operation. British South American Airways (BSAA) aircraft also took part. In addition, UK air charter operators joined the airlift with a variety of ex-military war surplus transports like the Halifax (renamed Halton), the Lancastrian, the York and the Tudor. The Airlift formally ended on 15 August 1949.

Some of the charter 'airlines' on the airlift went back to pre-war days but many were started as a product of the demand for charter capacity after the war. Apart from the re-emerging British National Carriers, these British 'Independent' charter operators formed the core of UK post-war airlines.

### 2.1.1 Imperial Airways / British Overseas Airways Corporation

During the 1930s, 1940s and until November 1950 Imperial Airways (to 1939) and then BOAC, operated services from Southampton/Poole to colonial possessions in Africa and Asia with Short 'Empire' and Short S8 Calcutta flying boats, transporting passengers and mail. BOAC also operated the Handley Page HP42 airliner for services through Europe and the Empire routes to India and South Africa, in its early days.

The Civil Aviation Act of 1946 lead to the demerger of two divisions of BOAC to form three separate corporations:

- British Overseas Airways Corporation (BOAC) - for Empire, North American and Far East routes
- British European Airways (BEA) - for European and domestic routes
- British South American Airways (BSAA) - for South American and Caribbean routes

In July 1949, BSAA was merged back into BOAC. In 1962, BOAC and the steam-ship cruise line Cunard formed BOAC-Cunard Ltd to operate scheduled services to North America, the Caribbean and South America. That operation was dissolved in 1966.

On 1 September 1972, the British Airways Board was formed, a holding board that controlled BOAC and BEA. On 31 March 1974, both BOAC and BEA were dissolved and their operations merged to form British Airways.

### 2.1.2 The Independents

The names of AVM D.C.T. Bennett (Imperial Airways pilot pre-war and RAF pilot for its duration) with his Tudors, Harold Bamberg with his Halifaxes/Haltons and Yorks, Fredie Laker with his Yorks and Tudors and many others, became part of the post-war scene. They moved on from participating in the Berlin Airlift to operating aircraft all over Europe and further afield. Initially they provided flights and then went on to provide accommodation in the new post-war packaged-holiday industry. They also flew on UK Military contracts, moving Service personnel and freight between bases worldwide. The charter airlines then broadened their horizons and vied with the National Carriers for licences to operate Scheduled Services. Many grew to compete directly with the 'established' operators BEA and BOAC, not only in The UK and Europe, but also all over the world, including the North Atlantic to the USA.

UK airline aircrews were mainly sourced from ex war-time Service flying personnel, who were issued with civil professional aircrew licences based on the new ICAO post war standards, by the then Ministry of Aviation. At one stage, as well as training pilots in the UK, BOAC operated a tropical training school in Soroti, North East Uganda. Later, BOAC and BEA went on to train their own pilots at their own College of Air Training at Hamble near Southampton and civil flying schools like CSE Aviation at Oxford. In due course more pilots were recruited from the post war National Service Short-Service commission stream and from the self-improvers who built-up their flying hours flying anything, or as instructors at aero clubs and at the smaller flying schools all over the UK. This enabled them to obtain their professional pilot licences and the coveted Instrument Rating, without which an airline career was an impossibility. Navigators and Radio operators were mainly ex Air Force, whilst Flight engineers came from the RAF and also from the pool of experienced ground engineering maintenance men.

Charter Airlines, like the long haul operator Skyways with its Yorks, Laker's Air Charter Ltd (Later Laker Airways), Bamberg's Eagle Aviation, later to become Cunard-Eagle Airways, British Caledonian (a post Berlin airlift start-up operation) and British United Airways were among those amalgamated from a number of smaller operations to form larger airlines. Like their National Carrier counterparts, all were essentially staffed with ex-military pilots. Initially, commands and co-pilot jobs were mainly given according to rank achieved in the war period Air Force, whilst a small number of younger civilian pilots with no military experience found their way into civil aviation at a time when the National Regulatory scene was haltingly finding its feet in the aftermath of War. At the same time, the post-war International Civil Aviation Organization (ICAO) was making its presence felt. It emerged as a unifier of Aviation Legislation in Montreal, Canada, where it is located to this day.

The UK airline crews and captains of this period were mainly the product of Bomber command who had survived operation tours over enemy territory. Captains were one-man bands, who relied on rank to assert their views on the rest of their crew. This attitude prevailed once they transferred to the civilian role as, at that time, there was no one to encourage them to be any different. It was laughable to see some 'Barons of the Atlantic' in BOAC with their idiosyncratic affectations, such as the wearing of white gloves when handling the controls, with some not talking to the flight engineer other than through the first officer (co-pilot). The Company did nothing to discourage such remoteness. Indeed Captains stayed in a different hotel to the one used by the rest of the flight deck crew on night-stops, who in turn did not stay in the same hotel as the cabin crew.

## 3. IT WAS CALLED 'TRAINING'

Dependent upon how one looks at the picture, it was in a way fortunate that the training environment that existed in some parts of the Civilian Airline scene I experienced at first hand, shaped my thinking on training matters from there on. In retrospect, when I made my first faltering steps as an airline pilot, the sad fact was that Civil Aviation was rather loosely regulated and airlines were not adequately supervised. Following a spate of fatal accidents, the Ministry of Aviation as the civil flying Regulator, created a Flight Operations Inspectorate to oversee airlines that had been awarded 'trooping contracts' to move Service personnel between the UK and their World-wide bases. In due course, the trooping contracts supervision activity was widened to cover all civil airline operations with the introduction of Air Operations Certificates (AOCs), after which formal requirements had to be met by every operator in the Industry, including training.

The unfortunate experience I underwent in my first years in the industry, illustrates the situation that prevailed in some areas, when I arrived on the scene armed with a single engine background and minimum instrument flying practise for the 'instrument rating'. It was a meagre backdrop to build on. I had practiced flying on instruments for about 10 hours on Dehmel D4 I/F trainers and managed a 45 minute flight on a twin-engined Airspeed Consul aircraft at Croydon, during which I flew a single Standard Beam Approach (SBA) let-down which was all that could be attempted in the one hour (chock-to-chock) sortie. That was all the preparation I got and could ill-afford, in the days when we were tested on how to fly radio-range 'airways' legs and when the audio-interpreted SBA was the let-down used for an Instrument Rating licence endorsement. My Instrument Rating test with the Civil Aviation Flying Unit (CAFU) Examiner at Stansted was in a Ministry of Aviation Consul, a comparatively small twin-engine aircraft. That I eventually passed, however much I felt unprepared, was most rewarding because the strict CAFU examiners gave nothing away.

### 3.1 THEY CALLED IT CONVERSION TRAINING

From there, as a new aspiring-to-be airline pilot clutching his brand new Commercial Pilot licence with Instrument Rating, I was offered a job as a co-pilot in my first 'airline' in June 1955 and was assigned to the Vickers Viking fleet, a monster of an aeroplane for someone with my very limited experience.

I then had 366 hours and 10 minutes flight time doggedly logged in a hard uphill struggle to build hours as a flying club/school instructor and RAFVR cadet pilot, after I obtained my PPL whilst studying at a Nottingham College in the early 50s.

As part of the Viking Fleet joining procedure and for my first airline aircraft type rating, I was given an "operations manual" to study. It was a foolscap document of 30 or so pages, containing Viking information printed on one side of each page. I was also allowed to sit in a Viking 'cockpit' for an hour, to familiarise myself with placards and aircraft instruments, before sitting a Viking Air Registration Board (ARB) technical exam. In those days the cost was £3 sterling per examination; the first of many, needless to say, rather more expensive, airliner technical exams that I underwent over the years. Subsequently, I trained in a more formal classroom tuition environment prior to the 'ARB', (later CAA) tests. During this first 'Viking ground school', I also went to the local library to read *Jane's all the World's Aircraft* to glean more information on the Viking, for this self-study conversion. Armed with the knowledge that the four-bladed propellers were 16¼ feet in diameter and that the Cylinder Head Temperature (CHT) sensors were fitted to cylinder head number 18, as gleaned from *"Jane's"* and other obscure sources, I passed first time, without the need to answer questions requiring such peripheral knowledge.

After having passed my ARB exam, I formally became a co-pilot in Eagle Aviation at Blackbushe on 20 June 1955. What I did not realise is that on that day I also started my command course in earnest, a command that I eventually gained, the hard way, five years later. I had to teach myself how to be a team leader, by observing during that period the style of good and bad company captains, all with a military background, some with an overbearing and dismissive attitude towards the rest of their crew. There were also many good men, who went out of their way to recognise that co-pilots, like me, needed help to become pilots in their own right and develop into safe airmen. These captains helped with friendship, good advice and handling practise.

The company had six "Training Captains", in addition to the chief pilot. He was a nice chap who preferred not to get too involved with training. Sadly, we co-pilots soon found out that training was neither part of their vocabulary nor in their modus operandi and we never seemed to be allowed to handle the aircraft when flying with any of the 'Trainers', throughout the years. To this day, I wonder and marvel at the disinterest that senior company management seemed to show towards training in those early days, paying lip service to the need for training by appointing so-called training captains, who were as ineffectual as they proved to be uncontrollable in training support terms.

In those days, pilot licences required a Group 1 or Group 2 Type Rating endorsement before an aircraft could be flown by the holder. A pilot with a Group 1 endorsement could test another pilot and sign out the paperwork for either a Group 1 or Group 2 Type Rating, to allow operations as a captain or co-pilot respectively. A Group 2 demanded demonstration of ability to carry out six take-offs and six landings unaided and to a satisfactory standard. A Group1 test included an engine failure at take-off and asymmetric circuit, an instrument approach and a landing. Any type rating also allowed one to fly as co-pilot on a non-public transport flight on any other type of aircraft (Twin or multi engine).

A few days after I was formally employed, the time came for me to be given flying training for a Group 2 Viking type rating, to allow me to fly as a co-pilot. Captains had to undergo the more demanding test, including asymmetric flying, to obtain a Group 1 endorsement that allowed them to fly 'in command'. I duly reported to my training captain and we went to the aircraft with no pre-flight briefing whatsoever. As was the norm in those days, pilots could sit in either seat for a sector, regardless of the type rating Group held. As such, if the co-pilot was given a handling sector, the pilots changed seat; unlike the present day when all handling is done from the seat normally assigned to captain and co-pilot, both by convention and flight deck design.

I was told to sit in the left hand seat of what, for me, was this monster of an aircraft. Then the engines were started by the training captain, who then taxied the aircraft to the runway on this early summer evening. We lined up and he said “Let’s go”. The next 45 minutes were a blur of getting airborne, turning left to ‘downwind’ in the circuit, lining up for the approach and landing for a ‘touch and go’. My hands and feet were on the controls but if truth be known, I was not really flying the aircraft. The training captain did it all … four times. The fifth approach was ended by a full stop landing, at which point I asked if he wanted me to taxi back to the head of the runway for the sixth circuit I was supposed to complete for the type rating endorsement. “No” he said, “I have a date with a gorgeous blonde in half an hour at the Crooked Billet in Hook and we are running late, so I will sign you out for six landings and will owe you one”. I am still waiting for that landing.

As I walked off the aircraft on that June evening in 1955, I knew what sort of a training captain I was going to be one day. Disappointment at my first airliner training sortie was immense, to say the least and I felt totally unprepared for my forthcoming co-piloting duties; indeed I was professionally naked in a manner of speaking, having only handled the aircraft ‘from downwind to finals’ five times.

It is interesting to note that training was also not particularly advanced elsewhere, in this case Canada during the 1950s. This short story received from Captain Ronald ‘Ron’ Macdonald, a now-retired long-haul captain who flew for a major Canadian Airline, illustrates it so well. Quoting:

***The heaviest thing I had flown was a single engine Fairey Firefly trainer when, after my new entry initial type-rating ground school, I climbed into a DC-3 with a so-called instructor. I started the engines and very carefully let the brakes off and started a slow taxi to the runway. He offered no briefing whatsoever and no instructions were given at any point. So I did the run-up magneto checks, taxied on to the runway, pushed up the power, eased the tail up keeping straight then eased back on the control column and was airborne. I called “gear up” (a two lever manoeuvre), eased back the power, did a circuit, put the flaps down, then the landing gear and successfully landed, all this with almost no comment from the instructor who then pushed up the throttles to full power as he changed the flap stetting for the next take-off and yelled “keep going”. He then throttled back one of the engines as we got airborne for the second time and left me to cope with the situation as best as I could. That was training in 1951 but you sure learned fast!***

### 3.2 THEY CALLED IT ‘ROUTE TRAINING’

Then came my ‘route training’ with the other ‘training captains’. Route training is now euphemistically known as *‘route flying under supervision’*, because training is not permitted with passengers on board. The message was pretty well the same from all. Sit, be quiet and do nothing. Speak only when spoken to and touch nothing. My first week in the air was a series of flights with a particular very senior ex-bomber command Training Captain, a glum, taciturn, distant and rather surly person. On that first night flight to Luxembourg, I sat behind him in the jump seat, to observe the operation, full of anticipation and excitement at this new life for me. I flew on seven sectors just looking from behind, with the same captain who hardly spoke, not even to say good morning or good evening on first meeting pre-flight. The week came and went and I just sat there doing nothing, never being spoken to. I was being merely ignored by this superior being who was too busy to talk to such a lowly creature as a new co-pilot. Some of the younger First Officers were friendly but other older ones and radio officers, only spoke a few words to me as even they seemed to take the lead from the captain’s attitude towards the ‘new boy’. The next time I flew again, was with him a week later. I was permitted to sit in the right hand seat but not allowed to do anything, not even the R/T communications. He did it all as the ultimate one-man band. There and then, this experience influenced my attitude towards training and how to deal with other crew members forever.

### 3.3 NORMAL LINE OPERATIONS

Once formally released to fly with other than training captains, it was many weeks before I was given a sector to fly by any of the captains. The Company had no continuation-training programme and it was left for captains to decide when and if to let the co-pilot fly a sector. In the absence of any guidance on the subject, it is probably not surprising that captains were reluctant to let unproven hands be placed on flying controls, let alone take-off or land.

I well remember the occasions of my first halting steps to handling a Viking, all with the same line captain. He was an ex Royal Navy pilot who had been a POW of the Japanese it was rumoured, though he never talked about this. He was considered as a bit of an eccentric, with his flowing full-set beard of best naval tradition, but J.P. was a really nice and considerate person, who became a very good friend over the years. After a trip to Dublin, when he gave me a take-off on one sector and a landing on the other, we were rostered to fly to Aden on a freight delivery flight via Malta and Wadi Halfa in the Sudan. I was thrilled to be given the whole of the Wadi Halfa to Aden sector in the left hand seat and, to cap it all, he gave me the opportunity for an asymmetric landing on arrival at Aden, which he talked me through in a calm, professional manner, notwithstanding that he was not one of the ‘Training’ captains. The confidence this gave me was indescribable and I will be forever grateful to him for his trust in my ability to fly ‘the pig’ as the Viking was known, because of its shuddering landings unless one knew how to handle the beast correctly. It was mainly thanks to this captain that, over a period, I got to grips with handling it all the way to reasonable returns to mother Earth, without morale-shattering rattling results. Needless to say, ‘handling’ sectors were few and far between when flying with others, particularly ‘training captains’.

### 3.4 IT WAS CALLED COMMAND TRAINING

Five years later I had amassed 5,000 hours as P1S / P2 and N1, having also undertaken a self- imposed task of taking star and sun astro-shots out of the open right-hand seat sliding window for my 'navigation plots'; pre-requisites for a Navigator ticket. I used my personal WW2 surplus ex WD sextant on the necessary 5 hours or more sectors, which were occasionally achievable on a Viking. Having flown with most, if not all, of the Company's captains on both short haul and long haul routes on Vikings then on DC-6 aircraft, I knew the sort of captain I did not want to be. I had made-up my mind by then, on whom I would mould my approach to command and how. Promotion was in the offing for me and I was assigned to one of the training captains for my command course, to undergo the whole of that pre-promotion training with him. A Viking Group 1 type-rating endorsement flight test followed.

Command training comprised a number of sectors in the left hand seat under the observation of the Instructor/Trainer, who sat there and watched my handling of both the aircraft and situations as they occurred. He never talked about anything operational or offered advice.

Seven sectors later, en-route to Rimini, I opted to turn back and land at Nice for a night-stop because the weather ahead looked most threatening. Remember that the Viking was an un-pressurised aircraft with no weather radar and a 10,000ft service ceiling. It was a dark and dirty night and I could see an unbroken line of Cumulo-nimbus clouds, with thunderstorm lightning illuminating the whole horizon from North to South. The frontal line of thunderstorms seemed to me to stretch all the way along the Italian West coast from Genoa to Rome. After landing and having arranged a hotel and transport thereto for the passengers and for the crew, my training captain said to me: "That was the right decision, Captain". It was his way of saying I had passed. I had at last *'made it'*. For me, the rest is history, as the saying goes.

The result of these experiences is that I have devoted the rest of my operational life encouraging 'TRAINING' pilots to become self-critical and to improve their own operational proficiency, as instructors who offer considerate and constructive tuition. When I became a UK CAA Flight Operations inspector, I promoted such attitudes so that they could help their trainees to grow into safe pilots and aircraft operators, from a position of knowledge and understanding of what is expected from a commander. Not one of individual guesswork on what a captain is or should be, in total isolation from instruction on good practises. This has been the focus of my life since that first day as an airline pilot at Blackbushe, in June 1955.

## 4. TRAINING NOW

After a slow tentative start to training their now civilian crews following World War 2 (WW2), the 'Corporations', BEA and BOAC, merged in 1974 into what is now British Airways (BA). They soon established robust Training Departments that pioneered the latest training devices and techniques, using up-to-the-minute sophisticated training aids; as did all the major operators of the Western world. Apart from the major operators, the proliferation of airlines that emerged after the war grew into respectable operations, most with good training practises thanks to the work of National Aviation Authorities (NAA) such as the UK Civil Aviation Authority (CAA) and its Flight Operations Inspectorate, encouraging the adoption of ICAO norms developed over the years.

In 2007, the European Aviation Safety Agency (EASA) became the European Union (EU) Aviation Regulator. The essential Requirements and Implementing Rules that EASA prescribes are progressively replacing many of the regulations that have been developed by the Joint Aviation Authority and implemented by EU States (such as the UK CAA) in their national regulation. The rest of the world is slowly catching-up, but there still are too many airlines out there with less than desirable operations and training set-ups, as accident statistics, sadly and repeatedly, continue to show.

### 4.1 SIMULATORS

The use of simulators has revolutionised the recurrent training and periodic testing required by legislation, removing the need to fly aircraft in abnormal configurations during refresher training and tests. No longer does flight in asymmetric configurations endanger life, limb and machine when simulating engine failures at take-off, should handling errors be made and accidents occur. Simulators have progressed enormously from their initial modest models.

I recall early World War II, United States Army Air Force 'Link' Trainers, where track flown was plotted as a 'Link crab' trace on the progress-map table. They were used for Instrument flying practise at first. Then came post-war successors such as the Dehmel D4, again just for Instrument flying practise. Eventually, the simulation Industry developed early fixed-base simulators (with limited two axes pitch & bank movement) and actual aircraft flight decks. They had no visual attachment and the flight deck was kept in night-time environment darkness. Pilots and flight engineers learnt all the cockpit checks and start-up procedures in that night environment, with no 'visual' and only limited movement. Pilots turned to line-up on a runway heading, pushed-up the power and did the whole flying exercise 'on instruments' after a 'blind' take-off on the given heading to get airborne. They then progressed to practising engine failures, just as the altimeter registered a climb.

General handling could be practised as well as ILS and ADF approaches, which were conducted all the way to touchdown, often in an asymmetric configuration; for example, two engines out of four on a multi engine aircraft type. It was all very exciting. The actual radio aids serving an airport were correctly reproduced and a record trace of the flight was observable by the instructor on a TV screen at his control console in the back of the simulator. From there, he could also input a variety of typical system failures such as electrical, hydraulics, pressurization etc, for the crew under training to cope with, all in a dark, visionless, night-environment flight deck.

Such older type-trainer simulators were not very realistic in control forces, often heavier but on occasion more sensitive than the real thing. After a two-hour session, pilots were usually very damp under the armpits. After many simulator sessions, they began to fly the real airplane on base training and often found it an absolute pleasure to operate, in contrast to the hard time they had when flying the simulator.

In due course, a semblance of 'visual' was developed and presented on TV monitors mounted in front of the windscreen, or projected on a screen in front of the simulator, but it was like being on a skating rink. The take-offs were hilarious as one slewed down the row of lights depicting the runway, doing 30 degree turns whilst attempting to keep straight. Soon after that, setting variable visibility and ceilings became possible, still at night and in the dark, but at least one could break out of the murk and land on an intended runway, all in black and white. The 'visual' was a TV camera running over a model of the area overflown, either mounted on a wall or on a large table. The system had limitations, as one could 'strangle' the camera wiring on its mounting on some layouts, if all turns were made in the same direction.

Simulators that followed boasted up to 4 axes of movement (pitch, bank, heave and yaw) and early computer-generated dusk or night images of airports and their surrounding terrain. These were eventually replaced by a colour day/night/dusk picture presented on 2, 4 or 6 channels giving the view on TV screens with, respectively, up to 4 mounted in front of the pilots and another 2 fitted so as to be viewed through the side windows, for an early wrap-around vision of the scene.

The phenomenal present-day advances in computing power has allowed the development of six axis, full-freedom of motion simulators, with 270 degrees of wrap-round day, dusk, or night full colour visual scenes of the highest fidelity. They offer stunning and most precise computer generated views of airports and surrounding areas; with amazingly detailed texture present and true radar altimeter readings that reflect the terrain contours overflown. The aircraft manufacturer provides fully faithful aircraft performance figures, throughout the flight envelope, to simulator constructors for incorporation in their products, permitting the use of their simulators for zero flight- time conversions to the latest aircraft types. Flight-test 'development' simulators initially use predicted performance, which is later updated after flight-test results are known, so that test pilots can fly prototypes even before they have come off the assembly line.

### 4.2 AIRCRAFT TYPE CONVERSION TRAINING

It is now 2009 and the training scene has changed immeasurably on all fronts. Crews are taught how to communicate more effectively and handling practise on simulators is of such reality as to be most effective in achieving the highest standards of piloting on conversion, with zero flight time in many cases, subject to conditions and used for continuation training or periodic testing.

The only discordant note is that of the ground school technical instruction courses given for the Regulatory Authority type-rating examination. Regrettably, these are of far less depth than in previous years, with the advent of *'Need to Know'* tuition only. This method, introduced by manufacturers and airlines to save time on conversion courses, only teaches systems as far as the point where the crew can do something about a problem by selecting a switch or checking a reading on an instrument fitted to the flight deck.

Further in-depth instruction is withheld, based on the peculiar reasoning that, if the crew cannot do anything about a situation beyond selecting parts of systems to OFF and/or to ON, such knowledge becomes unnecessary. It also reduces the cost of courses no doubt. In this day of complex inter-relationships of systems, this retrograde step should be reassessed, because understanding the very complexity of inter-systems dependability could explain certain unclear situations and resulting symptoms, in other seemingly unrelated systems.

For example, if the trickle charger of the Auxiliary Power Unit (APU) start-battery fails in flight after the APU is turned off on a B747-400, the battery discharges and other systems fed by this battery fail in consequence, with no apparent indication as to why but creating a state of affairs that crews cannot understand. I never knew that tit-bit following my '-400' ground school. I was perplexed as to why something unrelated had failed with no other indication, one night on the way back from Hong Kong. The pedestal FMC box gave me the answer. I interrogated the maintenance pages to see if I could find anything that would explain why whatever it was had failed. I think it was a fuel system component, if I recall correctly after 18 years.

We have gone a long way since 1955 but there still is room for improvement, particularly in respect of the need for more depth in ground school technical training courses. By improving the product, crews will have a better insight of their aircraft and so be better prepared to deal with system failures and emergencies.

Of concern is the need to maintain handling practise for pilots flying aircraft with automated flight decks, where auto pilots are used virtually throughout the flight; from soon after take-off to touch-down. Handling practice needs to be given more emphasis during recurring training periods when pilots are given the necessary periodic check required by Legislation.

### 4.3 COMMAND TRAINING

Yet another area where things have improved greatly in general, is better introduction to command before promotion, for those elected to undergo a command course. Major Western World, some Far East and large antipodean carriers in Australia and New Zealand, usually have a well-structured and carefully thought-out course syllabus to work to. Other operators also have command courses of varying quality, but these are few and far between in the Third World, where aviation is poorly monitored by weak NAAs, to say the least.

Generally, the opportunity is given to the pilot on the course to practise, first in simulators and later during route flying under supervision, handling the aircraft from the left hand seat after years of flying as a co-pilot in the other seat. The new commander must become accustomed to handling the control column or side-stick and the power levers with different hands. This should pose no problem for the average good co-pilot, who will have previously demonstrated his ability to fly to the required standards and carry out all duties required from a First Officer. He will have done this both on the ground and in the aircraft whilst operating from the right hand seat. However, he now needs to transfer acquired handling abilities from the right to the left hand seat and thenceforth, re-adjust mental processes and instinctive reactions. These include using the Transmit buttons on the control column … which hand to hold the ‘stick’ and the throttles with … where the Oxygen mask is stowed … maybe which ear will be in use with the headset … and which way to turn when spoken to. This goes for every stage of the flight and the complete operational spectrum, including where a cup is safely stowed when ‘refreshments’ are offered and maybe even which way to turn to accept it.

The more philosophical aspects of command are also covered in good command courses, which deal with such matters as general decision-making, dealing with the multitude of people that are involved in aircraft operations in general and one’s crew in particular, whilst not forgetting the cabin staff and passengers behind the flight-deck door. Conflict resolution and all the CRM precepts already covered in previous courses are probably reviewed, together with a Commander’s legal responsibilities. These and other areas should be addressed by a comprehensive course syllabus, with time also allocated to ‘opening the hangar doors’ to discuss ‘situations’ and how expected problems may be best addressed.

Unfortunately, not all airlines have forward thinking ideas and many still look to just handling ability as the primary criterion for promotion, in addition to seniority. Some operators may ignore even this latter proviso when employing direct-entry captains on the basis of past employment records. This is most regrettable as, quite often, unsuitable pilots slip through the net, both in handling terms and possibly in a hidden past-history of poor command qualities. Their company entry check including the necessary periodic checks are accepted by less than honest Instructor/ examiners for expediency and references are not taken. The problem with ‘references’ is that past employers are generally reluctant to tell the full truth about an ex-employee, or the reason an individual has left their employment. It is sad but that is the way of the world in these litigious days, when threats of Legal action float about as they do.


Leadership in action … © Captain Ralph KOHN, FRAeS

**END OF PART 1 - HISTORICAL**

## PART 2 - LEGAL ASPECTS OF COMMAND

### CONTENTS



### NOTA BENE

The Legal Aspects of Command covered in this Part (2) of *SO YOU WANT TO BE A CAPTAIN ?* can be found in EU-OPS regulations introduced on 16 July 2008. The regulations are derived and very similar to what was JAR-OPS 1.

EU-OPS are the transposition of JAR-OPS into EU law.

Summarising the differences between JAR-OPS and EU-OPS:

- EU-OPS 1 was implemented as an amendment to Annex III to EG regulation 3922/1991.
- EU-OPS 1 has become effective in all EU member states, plus Norway, Iceland and Switzerland.
- JAR–OPS 1 will remain effective in all other JAA countries.
- There are major changes on Cabin Crew training, All Weather Operations (AWO), carriage of Emergency Locator transmitters (ELTs) and Flight Times Limitations (FTL).
- New Sub part Q (Flight Times Limitations) are also known as EU-FTL.

Amended Regulations will be published as EASA-OPS in 2012. There are differences between JAR-OPS and EU-OPS but fewer differences between EU-OPS and what will become EASA-OPS. Meanwhile, JAR-OPS 1 now known as EU-OPS 1 became Law in July 2008 for all EC aircraft operations.

The underlying requirements for the operation of aircraft in the EC as held in EU-OPS, are derived from JAR-OPS 1, 2, 3 & 4. The new requirements might not be reflected in exactly the same terms but will have precisely the same intent, having been sourced from JAA Legislation. In the interim, the present duties of an aircraft captain are outlined in this Part as an introduction to the area of new responsibilities that will need to be addressed on promotion by those on a command course.

**IN PARTICULAR:** In this Specialist Document, references to sources derived from the Joint Aviation (Airworthiness) Authority (JAA) material will become EASA Law in early 2012; well after this document has been published. It is intended that an updated issue, reflecting EASA requirements where different, will be published in due course.

**Until such time as JAR-OPS regulations have been fully transcribed into EU-OPS, all other applicable references to JAR-OPS will be read to mean EU-OPS. The citing of legislation throughout this Document is only indicative; hence readers should consult the 'Source documents' to confirm the current amendment status**.

**APPLICABILITY : At the date of writing, the European Countries to which EASA regulations apply are:** Austria, Belgium, Bulgaria, Cyprus**,** Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland*, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxemburg, Malta, Norway*, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, The Netherlands and the United Kingdom.

* Since 1 June 2005 Norway and Iceland have participated in the Agency (and are hence members of the Management Board without voting rights) under article 55 of Regulation 1592/2002 as a result of Decisions No 179/2004, No 15/2005 and 16/2005 of the EEA Joint Committee which incorporate the Basic Regulation and its implementing rules into Annex XIII to the EEA Agreement.

## SECTION 1 - AUTHORITY, RESPONSIBILITY AND ACCOUNTABILITY

by Captain Seamus J.P. Lyttle, BSc, CEng, FCLIT, FRAeS

### 1.1 AUTHORITY: WHAT IS IT? … HOW DO YOU GET IT?

As a passenger, you have checked-in early for your flight and beaten the security queues; the crew have not even reported for duty; you are relaxed enough to tackle the crossword.

*The clue for 10 ACROSS reads* : Authority (7)…

Mmm... ? That is easy … *'power'*; … no … that is only 5 letters.

A pity they did not expand on the clue; like saying '*authority over'*. Yes, that must be it – 'control'; mmm …, could that be *'command'*? …

Keep an open mind … Flight called; time to spare now used up; paper folded and placed in briefcase for attention later… … *Now at home,* – (what would we do without air travel ?) – Wife at bridge; gin and tonic to hand; so time to catch up with the news in the paper and back to the crossword

'*Authority' ?* … Fourth letter 'e'... Niggled, you finally give in and reach for the Thesaurus. It is quite amazing to see the offering under the word 'authority'. What a list ! From four letters to twelve ! Acting with authority … *'consent'* ? … No; fourth letter is not an 's'; ***'licence'***? Eureka ! That is IT !

1.1.1 To 'have' authority

If only it were that easy? 'Authority' figures extensively in the pilot's domain. EU-OPS 1.085(f) states "the commander shall'… *'The commander shall:*

1. *Have authority to give all commands he deems necessary for the purpose of securing the safety of the aeroplane and of persons and property carried therein;*
2. *Have authority to disembark any person …..;*
3. *Not allow a person to be carried …..;*
4. *Have a right to refuse transportation ….;*
5. *Ensure ….;*
6. *Ensure ….;*
7. *Not permit ….;*
8. *Not permit ….;*
9. *Decide whether or not to accept ….;*
10. *Ensure …..'*

While EU-OPS 1.085(g) states: *'The commander or the pilot to whom the conduct of the flight has been delegated shall, in an emergency situation that requires immediate decision and action, take any action he considers necessary in the circumstances. In such cases he may deviate from rules, operational procedures and methods in the interests of safety.'*

These JAA Requirements are reflected in legislation and the Regulations of individual countries and given effect by their National Authorities, for example the CAA in the United Kingdom, and the IAA in Ireland. The wording of the various State Regulations may differ but the outcome is expected to the same (more or less!). Here 'Authority' is used in a different context – one used to identify an official entity, an agency of the state. So, what is meant by authority; what is the nature of authority? How does a commander 'have' authority; how does he get it and who gives it to him? Is there a process, a ritual laying on of hands, a handshake even? Maybe!

1.1.2 Nature of authority

The notion of authority is largely abstract. Only when it's exercised does it loose this nebulous characteristic. Considered from this perspective, authority involves the freedom or option to make decisions, to give orders. It involves the right to do something – to do it officially – to take certain actions. To **exercise authority** effectively the commander needs to be enabled, to have power. Part of this enablement is internal – how he goes about the job, deals with people – and part is external, the organisation or other sources. In the real world, if the commander cannot or will not exercise authority, then having authority by itself is academic. So, while we refer to the authority or the right to take certain actions, this does not necessarily include the ability or the where-with-all to deliver.

However, authority is not some freewheeling flight of fancy. Authority is constrained by significant limits or boundaries – the areas to which it applies. Not only are the notions of authority and power different, authority is invariably associated with obligation. EU-OPS 1.085(f)(1) states that the commander shall '*be **responsible** for the safe operation of the aeroplane and the safety of its occupants during flight time'*.

In parallel, the ICAO defines 'pilot-in-command' in Annex 6 (Operation of Aircraft) as:

*'The pilot **designated** by the operator, or in the case of general aviation, the owner, as being in command and **charged** with the safe conduct of a flight'.* This is a definition that invokes both authority and obligation. ICAO Annex 6, 4.5, specifies international standards under 'Duties of the Pilot-in-command'. In addition the operator is required to provide a *'statement defining the authority, duties and responsibilities of the commander'* in Chapter 1.5 of the Operations Manual

(Appendix 1 to EU-OPS 1.1045 refers). So, unfettered authority isn't there for the 'having' on its own. It is part of a package that also includes reporting, accountability and supervision.

### 1.1.3 Delegation of authority

If the commander is required to 'have' authority, how does he get it short of mounting a coup? No, nobody mentioned a 'coup-de-grace', though it is indeed sometimes seen as a case of filling dead men's shoes? In western organisations, of which airline operators might be considered an example (even if not quite typical), authority is the prerogative of the owner(s) and/or shareholders and it is exercised through the Board. The Board **delegates authority** to the chief executive (typically) and he in turn delegates specific authority to management; while they in turn delegate to supervisors and employees so that in their own position, each can fulfil their functions, discharge their duties and carry out their tasks.

This delegation makes sense as particular expertise and skills may only exist at various levels in an organisation, or with people in a particular position or in a group. So, authority is delegated from the top, down through the organisation to the Chief Pilot (as typically representative of Flight Operations management). It is the Chief Pilot who delegates authority, that is, Command of a flight to the commander and charges him with the safe conduct of the flight. It is the Chief Pilot who, after due process, does the metaphorical 'laying-on of hands'. He, or it might be she, does this after being assured of the competency and qualifications of the pilot; as an act of trust. It is in effect a contract of trust between his new commander and himself. It is a contract that imposes obligations on both parties. Fortunately, this happens once in a career and not before every flight. However, each and every time the commander is designated by the operator to command a flight this contract is renewed. It is not the seniority list that assures this designation, though it may indeed be part of the wider process.

### 1.1.4 Limitations and abuse of authority

The concept and practice of delegation of authority is not well understood in organisations and the practise not always adhered to. Authority can be rescinded. However, inappropriate intervention will negate or tend to negate the purpose and effectiveness of delegated authority can and has a similar effect to overturning it. Autocratic organisations, where the chain of command or lines of authority are short-circuited, often lead to cases of nominal authority where decision-making is often passed back up the organisation. Authority is regularly **usurped**. This can be overt pressure, like where senior management over-rules the engineering experts and their competence, by saying they were entitled to take responsibility because of their management functions. Such cases have occurred in airlines where, for example, during a schedule disruption, a senior manager has said that he would take the responsibility (even though not entitled or competent to assume that responsibility) and directed the commander to go. (Found out 6 months later during a Flight Times Limitations (FTL) audit).

Surreptitious overriding of authority commonly occurs e.g., pressure to accept an MEL item using insidious pressures to get the aircraft away from base, by emphasising the probability of schedule disruption and the effect on passengers, or by means of promises and/or insinuated threats from crew control. Situations slide when there is a failure by the commander to 'take control' and make or communicate decisions, or if he fails to take action. These lead to decisions by default, when external action pre-empt the commander and infringe his prerogatives. Sometimes pressures may even come from the part of crewmembers, both flight crew and cabin crew, who adopt unhelpful attitudes and positions that undermine his authority. Failure of a commander to exercise authority creates a vacuum as it were, a situation in which authority has to be assumed by others. On occasion, a co-pilot may have to assume authority, the commonly anticipated case being commander incapacitation. What's more, a case has been observed of an operations director flying with a 'minder' co-pilot who essentially managed the flight.

Even regulations and operating procedures can inhibit the exercise of a commander's authority. Considering the nature of a commander's delegated authority, it can be taken back although given.
It can be overruled though delegated in an organisational sense and it can also be usurped and undermined. A commander's delegated authority is reinforced in law to counter such risks. It is imposed by regulation, as discussed earlier, to ensure the safe operation of the aeroplane and the safety of its occupants in flight, during which time the commander is placed in command and charged with the safe conduct of a flight.

The commander's authority is vested in law. The cardinal rule is that exercise of authority during flight by the commander cannot be normally overruled. However, it may be necessary for another crew-member to question a particular decision, or seek clarification as to why that decision had been made.

### 1.1.5 Authority and responsibility, twin concepts

The symbiotic relationship between responsibility and authority is a cornerstone of western governance, even though it may not hold in all regimes worldwide. So much so that, in organisations where responsibility is **assigned**, it is almost automatically assumed that adequate authority is being delegated and resources allocated to permit the discharge of this responsibility. Thus, in the rules for Air Operator Certification, the operator must have nominated a post holder who will be responsible for the management of and supervision of Flight Operations (EU-OPS 1.175(i) refers). In the context of resources, the operator is required to have nominated an accountable manager, who holds corporate authority to ensure that all operations can be financed and carried out to the standard required by the State Authority (EU-OPS 1.175(g) refers).

Note that the accountable manager, though having corporate authority, is not responsible for Flight Operations; that particular management function is the responsibility of the post holder, who typically could be the Chief Pilot. Although he/she does not have authority formally vested by regulation, the authority delegated by the organisation and resources allocated would certainly have to match-up to the responsibility carried.

### 1.1.6 Operational Control

However, delegation of authority in airlines does not just rest on this presumption. An operator is required to *'Exercise **operational control** over any flight operated under the terms of his AOC',* according to EU-OPS 1.195(b). By definition, operational control is *'The exercise of authority over the initiation, continuation, diversion or termination of a flight in the interests of the safety of the aircraft and the regularity and efficiency of the operation.'* Clearly, the in-flight functions require the exercise of authority by the commander and are aligned with his responsibility for the safe progress of the flight. *'Initiation'* covers a number of pre-flight functions among which can be considered commander qualification and designation. Then *'Designation'* is effectively the point in the process at which authority is delegated by the operator to the commander of a particular flight.

ICAO definitions and standards have to address a number of regulatory regimes and in at least one of these, operational control is deemed to be addressed by a formal flight dispatch unit and co-shared authority with a flight dispatcher. Nonetheless, one way or the other, authority still has to be delegated to this operational level. ICAO states that '*An operator or a designated representative shall have responsibility for operational control.'* EU-OPS elaborate further, stating that an operator shall establish and maintain a method of exercising operational control that is approved by the National Authority. This also requires that the Operations Manual shall contain a description of the procedures and responsibilities necessary to exercise operational control with respect to flight safety.

Large airline organisations need to delineate the authorities and responsibilities of its operations personnel and provide procedures to co-ordinate their functions, but consider it desirable to designate one person in the organisation to have **overall operational authority** – operational control in its wider sense. EU-OPS reinforce this by requiring the post holder with responsibility for flight operations to have managerial competency, together with appropriate operational qualifications in aviation (Appendix 2 to EU-OPS 1.175 refers). This post holder is required to be acceptable to the National Authority. In effect, overall operational authority/control is conferred on the post holder for flight operations. So, a continuous line of delegated authority to the commander is established – from Board to chief executive to chief pilot to aircraft commander.

### 1.1.7 Designation of the PIC/Commander

Pilots properly licensed to act as Pilot-in-command/Commander are not entitled (as a right), to be designated to such a position; this is the prerogative of the operator. Whereas the operator is required to comply with the regulations and to ensure that commanders are qualified and properly licensed, it is the operator who is required to delegate the authority; as specified by regulation, to a commander, when designating him as such. The operator must ensure that no direction, instruction or intervention by the operator's personnel overrules exercise of the final authority of a commander in flight.

### 1.1.8 Authority, one of several concepts

This note has concentrated on the nature of the Authority of the commander, the source and delegation of that authority in the context of ICAO standards and compliance in terms of EU-OPS requirements. Authority does not stand in isolation. There is a relationship and interplay with other concepts, only briefly alluded to here. These concepts include, but are not limited to, duty and responsibility, reporting and accountability, power and direction, control and supervision, but also embrace judgement, leadership and discretion.

### 1.1.9 Summary

In functional terms, **the commander's Authority**:

- Is **delegated** by the operator.
- Is **vested** in law by regulation.
- Must be **exercised** to be effective.
- Can be **re-delegated** to other crew members.
- Can be **usurped, overturned** and **undermined**.
- Can also be **assumed**.
- Is **renewed** by **designation** as commander for each flight, as vested in Law.
- Command of a flight is **designated** by the operator.
- Designation is the **delegation** of authority.
- Command, conduct or operation of a flight embodies the **exercise of authority**.
- Designation also includes **assignment** of an onus of **responsibility**.
- The PIC/commander is **charged** with the safe conduct of a flight – meaning that he is responsible for the safe operation of the aeroplane and the safety of its occupants during flight time.
- Exercise of authority is **fulfilled**.
- Responsibility is **discharged;** and last but not least,

- Commanders are **accountable** for both their exercise of authority and discharge of their responsibility.

### 1.2 RESPONSIBILITY
**To be … *never* … not to be, twinned with authority**

The world makes lots of references to 'responsibility'. We are constantly admonished to 'be responsible', to 'take responsibility'. Cultural and social norms stress personal and societal responsibility. While these standards are more often set informally by custom, we are typically prompted to take responsibility not only for our own actions, but to be responsible for our children and of course the dog. Often, in the cases of any accident, injury or death, those affected want to know who was responsible – meaning, who is to blame. But that's a matter of accountability, assessment and judgement, of which more in a subsequent note. So, as seen in the relationship between authority and responsibility, the meaning and scope depends on usage.

1.2.1 The commander's responsibility

The condition of being responsible places an onus or obligation on an individual, or indeed on a group of people, or organisation such as the typical airline operator. Implicit in the discharge of a responsibility is the need to achieve and maintain a particular condition or state, such as 'a safe operation'. As stated in the ICAO definition, the pilot-in-command is *'charged with the safe conduct of a flight'*. Simply stated, it involves taking actions to achieve this by avoiding actions that can have an adverse effect. In essence, it means adherence to rules and standards and following procedures. As EU-OPS (1.085, Crew responsibilities) says: *'a crew member shall be responsible for the proper execution of his duties'*. These are the duties *'related to the safety of the aeroplane and its occupants'* and that *'are specified in the instructions and procedures laid down in the Operations Manual'*.

1.2.2 Do feeling and size matter?

To this extent, the responsibilities of both the commander and co-pilot are specific. The feeling of being responsible may well be nebulous and an expression of concern for the consequences if something should go wrong. There is no reason why a commander who does carry the additional responsibilities of command should necessarily feel any additional stress. He is trained, experienced and confident of performing his duties. In fact, he might feel less stress. It may be general practice to pay pilots more to fly larger aircraft on the spurious argument that they carry a heavier responsibility - spurious in the sense that it is difficult to correlate responsibility with size, considering that the nature of the specific responsibilities remains the same. So too does the nature of the consequences remain the same, though their extent could well be greater. But for the individual passengers and crew, the outcome is unlikely to be different. However, at the subsequent court of inquiry the learned members and public opinion might well think differently. Extending the scope of the commander's and co-pilot's responsibility in this way, to include less critical public usage of the term, does not facilitate understanding of just what is expected of pilots.

1.2.3 Responsibility during flight

The commander is only responsible for what happens during flight. Of course, this statement has its ambiguities. Where 'only' is placed in the sentence can change its meaning, and 'what happens' is vague, to say the least. EU-OPS 1.085(f), (Crew responsibilities), requires that the commander shall *'Be responsible for the safe operation of the aeroplane and the safety of its occupants during flight time'*. This neatly tallies with the ICAO definition which specifies the pilot-in-command as being *'charged with the safe conduct of a flight'*. It is well known that a safe operation is dependant on the supporting functions provided within the airline and by other agencies, as well as infrastructural facilities.

Regarding 'Conduct' of a flight, the function of the commander is the application and implementation of standards and procedures specified by the operator's flight operations management – the final stage of the safety process. Managers have responsibilities in line with their position and functions. While the management of safety may well be an integrated process within the operator's organisation, the responsibility is not a collective one – unlike the concept of collective authority and collective responsibility of cabinet style government, or Soviet and revolutionary committees. The commander has the singular individual responsibility for the safe conduct of the flight. This is not the same as saying that only the commander shall be responsible for the safe operation etc.

However, the 'here and now' during flight time, does have to be anticipated in some respects; for example, by flight preparation. It would be irresponsible to commit to a flight duty while unfit or likely to become unfit during the subsequent flight, as this could prejudice achievement of a safe operation.

1.2.4 The specifics of responsibility

A safe operation or the safe conduct of a flight, are general terms which embrace the whole responsibility. It is expanded and specified as rules and regulations, standards and limitations, instructions and procedures. The discharge of the specific responsibilities by pilots, including the commander, now becomes more a matter of conformity and adherence in the actions taken during the application and implementation of these elements. In the case of commanders, the need to make and take decisions in the context of these specifics, are part of his responsibilities. As might be expected, there is an exception or catch-all, an occasion when the commander is expected to use his discretion. In an emergency situation that requires immediate decision and action, the commander *'shall take any action he considers necessary under the circumstances'. In such cases he may deviate from the rules, operational procedures and methods in the interest of safety'*.

Other situations can arise which are not necessarily *'an emergency situation that requires immediate decision and action'*. Such a situation may not be addressed by the promulgated rules and procedures. Because the commander is charged with the safe conduct of a flight, this imperative could require the commander on assessment to make and take a decision on the balance of probabilities, to ensure a safe outcome.

1.2.5 Responsibility assigned

The responsibilities of commanders are defined and assigned by the operator and contained in the Operations Manual within which is required to contain a section headed: *'Authority, duties and responsibilities of the commander'* (Appendix 1 to EU-OPS 1.1045). Obviously, the operator is bound to take account of State regulations. Whether these are considered to be superimposed on, or to reinforce the operator's responsibilities for commanders, is less important as they form part of, and are interwoven with, States' regulation of operators. The question becomes more significant when the accountability of commanders is considered in the next section. (In the case of a flight operated by an individual owner, the responsibilities are those placed on the pilot by State regulations.)

The nature of responsibility is such that although it has been assigned in the past, its discharge occurs in the present ongoing situation and will be accounted for in the future. Its assignment occurs as an element and principle of an organisation's process of job and task allocation, which sets out what each person is expected to do. Usually the standards expected to be achieved when performing it – in other words, the duty and obligation bit. As it is embedded in and is *'part and parcel'* of the job, responsibility cannot be reassigned.

1.2.6 Overall responsibility

Where the job requires supervision and control over others, such as by a manager, it will involve assignment of responsibility to the people being managed; but the manager still retains an obligation of overall responsibility. Thus the commander has overall responsibility for the conduct of a flight, which includes the activities of his crew. Therefore if, for example, a co-pilot is delegated and made responsible for the task of supervising the refuelling, performing the external pre-flight check or preparing a load sheet, the commander is still charged with the responsibility of assuring that these tasks have been carried out, in whatever way deemed appropriate.

The load sheet is normally prepared by Ground Operations personnel but the onus is on the commander to make certain checks to assure him of its accuracy, before signing it off. This is one of several activities. For example, the Technical Log record of actions performed by personnel not directly under the commander's control. Here he reviews certified documentation, which he accepts or indeed may reject, as he exercises his authority and the discharge of his responsibility for the safe operation of the aeroplane.

1.2.7 Summary

*Commander's responsibility:*

- The commander is **charged** with the safe conduct of his flight;
- It is the commander's responsibility to **make and take decisions** – to command.

*Responsibility:*

- An **onus or obligation** to achieve a safe operation;
- **Assigned** by the operator;
- **Charged** by regulation;
- **Discharged** by proper execution of duties;
- **Not re-assignable** on to others;
- Cannot be **rejected** by the person to which assigned.

***Overall responsibility*** *includes*:

- Responsibility for the **actions of subordinates** – e.g. crew members;
- Responsibility to **assess the product** or outcome **of others' activities**, where these affect or impact on the basic responsibility assigned to the commander.

## 1.3 ACCOUNTABILITY

1.3.1 Accountability of the commander

It is not unusual to be asked to 'account for' something. As very young people, we could have been asked to account for how we spent our pocket money. As adult people, we are still likely to be asked how we spent 'the' money and just as likely to be asked to account for our actions. At face value, the verb has a pretty innocuous meaning: to *'regard in a particular way'*. However, when combined with a preposition or two, the connotations can have implications that are altogether more sinister. For example, *'to account for'* means '*to 'give a satisfactory explanation of something'* while *'call to account'* means *'require someone to explain poor performance'*.

1.3.2 Accountable – what the dictionary says

'*Accountable'* means *'responsible for one's actions and expected to explain them'*. Using the alternative word '*answerable*' brings out the dual aspects of the meaning.

A person is answerable *for* something and answerable *to* someone entitled to ask for an explanation. So, a commander is answerable / accountable for the discharge of his responsibility, for execution of his duties, for the exercise of authority and for the use of discretion. He is answerable to his boss, the chief pilot, of course… but aviation is not that simple! Maybe we need to consider who might be entitled to ask the questions and who is entitled to explanations?

Let us first take a brief look at accountability, as a process within the sequence of the overall scheme of activities. Broadly, the sequence consists of:

- Allocation – assignment and delegation;
- Application – discharge, exercise and execution;
- Accountability – inquiry and explanation;
- Assessment – findings and judgement;
- Attribution – of competence, or of inadequacies and error, or of culpability and blame;
- Consequences ***** – commendation, recommendation, disciplinary action, legal processes and liability.

***** If you want all to start with 'A', try 'Aftermath' but this excludes the positives of competence and commendation, which should be included to counteract the negative connotation mentioned above.

This sequence is an attempt to show the limits of scope for accountability. It does necessarily conform to textbook rigour. Other commentators might well include 'assessment' within the scope of the process and others again might go a step further, but it seems that attribution of blame goes too far. Certainly, the consequences of disciplinary action and sentencing and punishment are well outside its scope. However, regarding authority and responsibility, as indicated in the two previous notes, the broader scope of accountability might well be determined by the public perception of usage and by context.

1.3.3 The company channel

As the manager or post-holder responsible for flight operations, the chief pilot needs to know what has happened on the line and needs feed-back to discharge his responsibilities. If an event occurs, he looks for information. He wants to find the facts. He needs to find how you, as the commander, responded to the situation. Was the checklist adequate? Were the procedures adequate? Did you as the commander have enough guidance information to address the problem? The questions asked and the explanations sought can be extensive. These do not have to be a person-to-person exchange. Most information is provided routinely by reports. But the reader needs to also be aware of the use of data-links which provide feedback while 'en route'.

1.3.4 Reporting and investigation – elements of accountability

Reporting requirements include:

- The regular journey log;
- Completion of the OFP (operational flight plan) to provide feedback;
- Occurrences (incidents and accidents) required by regulation;
- ASR's (Air Safety Reports);
- MOR's (Mandatory Operational Reports);

Line checks, OFDM (Operational Flight Data Monitoring) and LOSA (Line Operational Safety Audit) systems provide feedback.

Incidents have to be evaluated by the operator. The incident investigation, usually conducted by the Flight Safety Officer / Accident Prevention Adviser, may entail questioning and seeking of explanations from the commander, as well as other relevant personnel within the operator's organisation.

Most operators will provide for a Confidential Reporting System, usually under the auspices of the Flight Safety Officer.

Accidents or serious incidents are normally investigated by the State Agency that has this remit. Again, and assuming their survival, the commander and crew are likely to be questioned and explanations sought.

These elements of accountability – the reporting and investigatory systems – stop short of the attribution of blame. However, accident investigation by the State shows that accountabilities can be and are due to agencies outside the operator's organisation. While there is little doubt that the State Authority can hold the commander and pilots, accountable for compliance with regulations, the Authority usually chooses to bring accountability to bear through its supervision of the operator. As a last resort, the State Authority can take legal action against the individual pilot or commander. In some jurisdictions, a State Authority 'Conflict between departments' can arise and the commander needs to recognise that this is not easily handled. (Editors' note: lots of UKFSC evidence of this overseas).

1.3.5 The legal processes

The legal processes differ from rendering accountability. Though investigation, explanations offered and facts found, as part of the legal process, appear to correspond with the exercise of accountability, the purpose and aims differ. The legal process postulates a charge to be proved, a case to be answered, conclusions to be drawn, blame to be attributed and apportioned, and sentence to be passed or fine imposed. Some would say this is the real purpose and outcome of accountability. But, how can an obligation be discharged by punishment or paying a fine? The dictionary says otherwise.

1.3.6 Accountability – two end-results

Incident and accident investigation focuses on determining cause; the probable cause and contributory causes, though determining the causes could be indicative of culpability. However, inquiry and explanation, findings and conclusions may not turn out to be indicative of any culpability but rather of competence. In which case, the consequence ought to be commendation and not disciplinary action. Disciplinary action cannot be started until the causes are known and blame attributed.

1.3.7 The commander – accountable to whom?

By definition, the commander is *'charged with the safe conduct of a flight'*. The commander is *'responsible for the safe operation of the aeroplane and the safety of its occupants during flight time'.* So, who is the commander accountable to? Surprisingly, pilots give a wide spread of answers. These include, the operating company, the State Authority that issues the AOC, the travelling public (the passenger), the taxpayer (state airline), the pilots' union and it wouldn't be any more surprising to find the media included, or more recently even the world-wide-web! There are, of course, only two answers - the operator and the State Authority. The operator designates the commander, assigns responsibility and delegates authority. The Authority acts as a proxy for the passenger (the so-called travelling public). Moreover, as seen above, the Authority tends to demand accountability through its supervision of the company's operation, rather than directly. Crew members are responsible for the *'proper execution'* of their '*duties'* that *'are related to the safety of the aeroplane and its occupants'* and *'are specified in the instructions and procedures laid down in the Operations Manual'.* So the main routing of accountability for commanders is through the organisational channels of the operating company.

1.3.8 Summary

The commander is **accountable for**:

- the discharge of his responsibility;
- the execution of his duties;
- the exercise of authority;
- the use of discretion; and
- compliance with regulations.

Accountability is:

- about **whether and how** the commander discharges these obligations;
- about providing **explanations** and answers;
- not about attributing blame.

The commander is ultimately **accountable to**:

- his operating company;
- the State Authority.

**SECTION 2 - TAKING COMMAND**
by Captain Philip H.S. Smith, MRAeS

The cry that aircraft commanders have had their authority taken away from them is not a new one. It was certainly being voiced in the early '70s and no doubt before. Legally it is quite clear that this is wrong. In the UK that authority currently derives from and is laid down clearly in EU-OPS 1.085 (f) which starts: *"The commander shall:"* and continues in sub-paragraph 3: *"Have authority to give all commands he deems necessary for the purpose of securing the safety of the aeroplane and of persons or property carried therein;".* This is clear and straightforward language: *"give **all** commands"* and *"**he** deems necessary".* No question, there, of giving only those commands that will not cost too much, or asking someone else whether they consider a command necessary.

That being the case, why is the contrary perception so widespread? Is it that the perception is faulty? In any particular case, it can be hard to judge whether authority was exercised as it should have been, and in any case, such a judgement is inevitably an exercise of hindsight, laced with information and often lengthy analysis not available to the commander when the decision was made. However, I think most people would agree that incidents in which there is the appearance of a commander's judgement having been, at least, unduly influenced by outside agencies, are more common than they were in the past.

Partly this is a consequence of better communication. When Ernest Shackleton left South Georgia on 5 December 1914 on his abortive expedition to cross Antarctica via the South Pole, he had no possibility of communication with anyone beyond his crew until he reached a whaling station on South Georgia in May 1916, nearly eighteen months later. Accounts of his character suggest that anyone trying to usurp his authority would have received a dusty reply, but in the absence of communication, there was no such possibility. Excellent communications allows a commander to seek information and advice if time is available, but it also allows operators or outside agencies to attempt to compel a particular course of action.

It is too much to expect even the best-informed and most carefully briefed commander to have committed to memory or have at his fingertips all the information that might be of use in every conceivable situation. A prudent commander, faced with a critical situation, will acquire all relevant information he can, in the time available before he makes a decision. He will probably want to seek advice from specialists in areas, such as security, where such specialists have access to sources not available to an aircraft commander. But neither the commander, nor the source of information or advice, should forget that it is no more than that. A request for information must not be taken as a request for instructions.

The operator, personified by the commander’s managers, may try to dictate what their commander should do. This is understandable in a world in which a manager’s next pay rise and promotion may depend on the outcome, and especially the perception, of a decision made by someone they manage. Sometimes an operator’s standing instructions may point to a course of action that is inappropriate in the circumstances on the day. Outside agencies such as security authorities may also feel that they have the right to compel a particular course of action. The responsibility they bear is heavy and their priorities are wider than those of the commander of an aircraft. Nevertheless, neither the operator nor any other agency can take over command of the aircraft.

As pilots are fond of saying, ‘at the subsequent enquiry’ the commander will be held responsible for a decision and its consequences. When a decision based on advice received from outside is called into question, it will inevitably be asked if undue weight was given to the advice. Advice and information that turns out to be misleading may be offered in mitigation, but it will not absolve the commander of his responsibility. Nor will those who supplied the advice or information take responsibility for the decision, though they may have to bear the responsibility for the information or advice offered. Commanders must not forget this. If they receive what seems to be an instruction, the commander bears the responsibility for complying with the instruction. The commander’s judgement should be informed by the best information and advice available in the circumstances, but only the commander can make the decision. If advice indicates a course of action that is wrong in the judgement of the commander, then it is the judgement of the commander that must prevail. That is what an aircraft commander is paid for.

The scrutiny of decisions with hindsight is damaging. It is an inefficient method of management, because it leads to unwarranted conclusions. It may damage the confidence of a commander and engender hesitancy to make a decision on the next occasion. This is not to say that when a critical decision has been made, whatever the outcome, it should not be subjected to careful examination. The publication of the details of incidents and their outcome, together with decisions made along the way, contributes greatly to the safety of aviation. What must be avoided is the suggestion that a different decision would have been ‘better’ on the basis of hindsight and analysis carried out with unlimited time and information not available to the commander on the day.

So the authority of an aircraft commander has not been taken away, but it may be given away. Sometimes perception becomes reality. If commanders believe that their authority is reduced, they will be more reluctant to exercise their authority. This is dangerous. Aviation, and in particular the aircraft operator, needs Captains who are not just competent to make decisions but ready to exercise authority when necessary, particularly when difficult and speedy decisions are required. Aviation cannot be safe without them. Commanders must take command.

## SECTION 3 - PILOTING TERMS: A REVIEW OF ICAO JAA AND EU SOURCE MATERIAL

by Captain Tim Sindall FRAeS

### 3.1 INTRODUCTION

ICAO Annexes contain Standards and Recommended Practices (SARPs) that, together with the accompanying Definitions should be incorporated by Contracting States within their framework legislation. As regards Contracting States that are also members of the European Aviation Safety Agency (EASA), this latter organisation is responsible for developing SARPs etc, for implementation by Member States. The vehicle used hitherto for promulgating these regulations has been the Joint Aviation Requirements Operations 1 (JAR-OPS 1), which has now been replaced by EU-OPS 1. The review you are now reading has been based upon EU-OPS 1 and JAR documents which have now become the EASA requirements for both OPS and FCL. Part 1 of the document summarises the different descriptions used, mainly with regard to the commercial air transport use of aeroplanes, and Part 2 lists references and texts.

The reader will observe certain differences between ICAO Annex and EU/EU-OPS texts, where the latter introduce terms not used in the former: this process is perfectly acceptable provided the meaning intended by ICAO is not lost.

### 3.2 SUMMARY OF TERMS USED

***Pilot-in-Command:*** The ICAO term ‘pilot-in-command’ includes a privilege conferred by the holder of a valid commercial or airline transport pilot’s licence or, indeed, a private pilot licence. ICAO also uses this term to define a pilot designated by an operator or aircraft owner who is to be responsible for the safety of a flight. Some States (e.g. the JAA) prefer to use an additional term - 'commander'- to better define the latter: this is used to specify responsibilities and accountabilities.

***Captain:*** The term 'captain' is not defined in ICAO Annex material or in EU-OPS, but is often used in other documents, such as flight manuals, to describe particular duties or functions relating to specific checklist items that normally would be carried out by the occupant of the left-hand seat of an aeroplane. Some aeroplane manufacturers use other means to describe this individual, e.g. 'crewmember 1' (CM1). The term 'captain' is also used commonly as a sobriquet (courtesy title) to describe a pilot who within a company has attained a position of authority.

***Co-Pilot:*** As with 'pilot-in-command', the term 'co-pilot' can be used in relation to licence privileges, but is often used to describe a pilot other than the 'commander' and who is assisting the latter. It can also be used in relation to duties or functions normally carried out by the person occupying the right-hand seat of a multi-crew aeroplane: one manufacturer once used 'CM2' to define this role. ('CM3' would be used to describe a flight engineer or systems panel operator, for example). Some operators differentiate between inexperienced and experienced co-pilots by describing them as 'first officer' and 'senior first officer' respectively, both terms defining their role in the company hierarchy.

***Pilot Flying:*** EU-1 (applicable to both commercial air transport and general aviation) describes 'pilot flying' (PF) as, 'the pilot who for the time being is in charge of the controls of an aircraft. This is a task assignment only and should not be confused with the command authority of the pilot-in-command.'

***Pilot Not Flying:*** EU-1 describes 'pilot not flying' (PNF) as the pilot who is assisting the 'pilot flying' in accordance with the multi-crew concept when the required crew is more than one. Some operators use equivalent terms, such as 'pilot monitoring' (PM).

*Example 1:* The following example demonstrates how all these terms can be used in conjunction with one another. When employed as a CAA flight operations inspector, I used to remain in contact with commercial air transport operations by flying with various UK air operators in the capacity of 'captain'. That is to say, I would occupy the left-hand seat in e.g. an Airbus A300-600 and action the 'captain' or CM1 tasks published in the relevant checklist. With me there would always be a training captain who sat in the right-hand seat. Both of us had 'pilot-in-command' privileges in our licences, but my colleague was designated 'commander' of the aircraft and so had legal authority and responsibility for the safe conduct of the flight. He would action the 'co-pilot' or CM2 tasks. The 'commander' could overrule my decisions at any time. When conducting low visibility approaches, my colleague would invariably be 'pilot flying' and I would be 'pilot not flying', until such time as I took over control for the landing, when the roles of PF and PNF would be reversed.

*Example 2:* The second example demonstrates how the terms can be used when an augmented crew is used to extend the flight duty period limitations, say by rostering three pilots to the task, all of whom have 'pilot-in-command' privileges in their licence. One of the three will be designated 'commander' yet, in accordance with OPS 1.085 (g) he/she can lawfully delegate the conduct of the flight to one of the two remaining pilots at such times as he/she leaves the flight deck. According to where each pilot is seated at the controls, he/she will undertake the related 'captain/CM1' or 'co-pilot/CM2' tasks and, according to agreements arrived at internally by the flight crew (subject to training and qualifications provided by the operator), either seated pilot may in turn undertake PF and PNF roles.

## 3.3 SOURCE MATERIAL

### 3.3.1 ICAO Annex Material

ICAO Annex 1 – *Personnel Licensing* Descriptions show 'pilot-in-command' as, 'The pilot responsible for the operation and safety of the aircraft during flight time'. This description applies across the board to the piloting of all aircraft and to all types of operation (i.e. Commercial Air Transport (CAT) and General Aviation (GA), the two broad divisions used by ICAO. The holders of valid commercial and airline transport pilot licences enjoy the privilege that they may (subject to some restrictions) 'act as pilot-in-command' or as 'co-pilot' in the aircraft type contained in their licence. 'Co-pilot' is described as, 'A licensed pilot serving in any piloting capacity other than as pilot-in-command but excluding a pilot who is on board the aircraft for the sole purpose of receiving flight instruction'.

ICAO Annex 6 – *Operation of Aircraft*, Part I – *International Air Transport, Aeroplanes*, refines the Annex 1 definition of a 'pilot-in-command' to become, 'The pilot designated by the operator, or in the case of general aviation, the owner, as being in command and charged with the safe conduct of the flight'. With regard to this more narrow definition, the Annex contains in paragraph 4.2.10 the requirement, 'For each flight, the operator shall designate one pilot to act as pilot-in-command'.

ICAO therefore uses the term 'pilot-in-command' in both broad and narrow contexts. To emphasise the difference between both contexts, some States have introduced a new description, 'commander' to apply to the 'pilot-in-command' described in Annex 6. Whilst this in no way changes the intent of the ICAO Annex 6 description, it makes clear the singular position held by 'the person designated by the operator' and the associated responsibilities (and authority) attaching to this person.

### 3.3.2 EU Joint Aviation Requirements

JAR-FCL 1 used the term 'pilot-in-command' in the same manner as is contained in ICAO Annex 1, i.e. as one of the privileges conferred upon the holder of an appropriate licence.

EU-OPS 1 introduces the term ‘commander’ in OPS 1.940 (a)(5) as, ‘An operator shall ensure that: one pilot amongst the flight crew, qualified as pilot-in-command in accordance with requirements governing Flight Crew Licences is designated as the commander who may delegate the conduct of the flight to another suitably qualified pilot’. OPS 1.085 lists many of the commander’s responsibilities together with his authority to delegate, and OPS 1.090 describes the authority of the commander. Thus, EU-OPS 1 makes clear the accountabilities of that ‘pilot-in-command’ that the operator has designated to be the ultimate authority during the flight. This ensures that when more than one ‘pilot-in-command’, as described within the holder’s commercial or air transport pilot’s licence, forms part of a required flight crew, there can be no doubt as to where responsibility for the safety of the flight resides.

These arrangements do not preclude, for example, the formal hand-over in flight of command authority from one ‘commander’ to another in ultra long range operations, where two flight crews are required to enable the aircraft to remain airborne beyond what hitherto has been agreed as an acceptable flight duty period. The off-duty crew can therefore obtain uninterrupted and recuperative rest. In this case, the passengers have the legal right to know who the commander is and should be informed accordingly at some suitable time after the hand-over in flight.

JAR 1 referred the reader to JAR-OPS (aka EU-OPS) for a definition of ‘commander’, and describes a ‘co-pilot’ as, ‘A pilot serving in any piloting capacity other than as a pilot-in-command or commander but excluding a pilot who is on board the aircraft for the sole purpose of receiving flight instructions for a licence or rating’. JAR-1 also defined the roles of PF and PNF as described above.

### 3.4 CONCLUSION

This paper has explained the related terms used in flight deck task management as developed from ICAO material by one State (effectively the EU reflecting work carried out previously by the JAA). No doubt, other States have slightly different terms, as is their right, but for Europeans there is one set of descriptions that allows considerable flexibility in crewing commercial air transport aircraft. (In Legislation, Commercial Air Transport was previously referred to as Public Transport).

## SECTION 4 - THE LEGAL RESPONSIBILITIES OF AN AIRCRAFT CAPTAIN

Background material on the UK situation before the advent of EASA EU-OPS
by Philip Shepherd QC

### 4.1 AIRCRAFT COMMANDER AND THE LAW

4.1.1 This article aims to outline the main rights duties and obligations placed on the commander of aircraft operated in the commercial air transport category and registered in the United Kingdom. The law distinguishes between obligations placed on the commander and those placed on an operator of any such aircraft – for example it is the operator of an aircraft registered in the United Kingdom who must not permit the aircraft to fly for the purpose of commercial air transport without first designating from among the flight crew a pilot to be the commander of the aircraft for the flight[1];

4.1.2 It aims to be a practical guide to the laws that are most likely to be relevant in practice – it is not intended to be exhaustive[2].

### 4.2 THE LEGAL FRAMEWORK

4.2.1 The framework in which such laws operate is inevitably international. There are numerous international treaties that affect aviation – for example the Chicago Convention of 1944 and the Warsaw and Montreal Conventions. Not all treaties become part of English domestic law – in the UK, no treaty becomes law unless and until it is given legal force by an Act of Parliament. So for example, the Warsaw Convention of 1929 was given the force of law in the UK by the Carriage by Air Act 1932.

4.2.2 For practical purposes a commander will be principally interested in the relevant provisions of statute law, meaning laws contained in Acts of Parliament and in any regulations made under those Acts – for example, the Air Navigation Order 2005 is made under powers conferred by a number of Acts including the Civil Aviation Act 1982.

4.2.3 Broadly speaking English law can be divided between (a) criminal law the breach of which results in a prosecution in a criminal court and is enforced by the State, or State organisations such as the CAA and (b) civil law which is concerned with the rights and duties of citizens as between themselves and which is enforced by the injured party in the civil courts– for example an injured passenger may sue the airline in the High Court to recover damages for his injuries and losses arising out of an accident.

4.2.4 For all practical purposes the commander of a commercial air transport aircraft will be covered against claims made by third parties by his employer’s liability insurance policies for virtually all forms of civil liability arising out of or connected with aircraft operations. Since 1932, crew have in any event been entitled to claim the same limits of liability that have been given to carriers under the Warsaw and then the Montreal Conventions.

[1] Air Navigation Order 2005 42(1)(a)
[2] For example crew licensing IS NOT addressed, as to which see Articles 26-28 Air Navigation Order 2005

4.2.5 Civil and criminal liability can arise out of the same incident. If for example an accident was caused by the aircraft not abiding by operating minima a criminal prosecution in the Crown Court under the Air Navigation Order 2005 may also result against the commander and/or the operator.

## 4.3 THE MAIN STATUTORY PROVISIONS

4.3.1 The obligations placed by the law on the commander of an aircraft are frequently backed up by criminal sanctions – so under articles 52 -54 of the Air Navigation Order 2005 it is up to the commander of an aircraft

a. to take all reasonable steps to satisfy himself before the aircraft takes off that the flight can safely be made, taking into account the latest information available as to the route and aerodrome to be used, the weather reports and forecasts available and any alternative course of action which can be adopted in case the flight cannot be completed as planned;

b. who is obliged to ensure that the aircraft is in every way fit for the intended flight, and that the certificate of maintenance review is in force;

c. who must ensure that the load carried by the aircraft is of such weight, and is so distributed and secured, that it may safely be carried on the intended flight; and that hazardous cargo is correctly classified, labelled, identified and notified as required;

d. to ensure that a safe margin has been allowed for contingencies, and, in the case of a flight for the purpose of commercial air transport, that the instructions in the operations manual relating to fuel, oil and engine coolant have been complied with;

e. who must be satisfied that the aircraft is capable of safely taking off, reaching and maintaining a safe height thereafter and making a safe landing at the place of intended destination;

f. who must ensure that safety briefings are given and that passengers and their baggage are securely stowed.

4.3.2 The commander can in some cases delegate such duties to others in the crew but the buck well and truly stops with him – he or she will be the one standing in the dock if caught breaching any of these and many other obligations that the criminal law places solely on the shoulders of the commander.

4.3.3 Potential criminal liability is sometimes expressed in terms that are not specific to the commander of an aircraft – so for example endangering safety of an aircraft applies to anyone who does so, including potentially the commander, under Article 73 of the Air Navigation Order 2005 "A *person shall not recklessly or negligently act in a manner likely to endanger an aircraft, or any person therein*". But this section can apply to the commander as well as any other person. Note that for this section, negligence is enough; meaning - in the case of a pilot - falling below the standard to be expected of a reasonably competent pilot holding the licences held by the pilot in question.

4.3.4 But in addition to criminal liability, statute law also specifies the legal authority of the commander of an aircraft. So Article 77 of the Air Navigation Order 2005 provides that "Every *person in an aircraft shall obey all lawful commands which the commander of that aircraft may give for the purpose of securing the safety of the aircraft and of persons or property carried therein, or the safety, efficiency or regularity of air navigation".* But what does "*lawful command*" mean – this is not defined. It would be reasonable to interpret that it means any command which, in the opinion of the commander, is directed at ensuring safety, efficiency etc. Plainly, the command has to be delivered in a lawful way, but what is lawful depends on the facts of each case – so dealing with a terrorist hijacker may lawfully call for the most extreme measures that are not called for when a passenger is caught smoking. In practice, judges tend to err on the side of the commander and do not tend to be overly critical of any action that falls within a very broad range of reasonable responses.

## 4.4 SECTION 94 CIVIL AVIATION ACT 1982

4.4.1 The legal rights of a commander are also addressed in section 94 of the Civil Aviation Act 1982 that applies to all aircraft commanders undertaking any category of flight. It specifies that if the commander of an aircraft in flight, wherever that aircraft may be (and this means what it says), has reasonable grounds to believe in respect of any person on board the aircraft —

a. that the person in question has done or is about to do any act on the aircraft while it is in flight which jeopardizes or may jeopardize —

   i. the safety of the aircraft or of persons or property on board the aircraft, or

   ii. good order and discipline on board the aircraft, or

b. that the person in question has done on the aircraft while in flight any act which in the opinion of the commander is a serious offence under any law in force in the country in which the aircraft is registered, not being a law of a political nature or based on racial or religious discrimination, then the commander may take with respect to that person such reasonable measures, including restraint of his person, as may be necessary:

   i. to protect the safety of the aircraft or of persons or property on board the aircraft; or

ii. to maintain good order and discipline on board the aircraft; or

iii. to enable the commander to disembark or deliver that person.

4.4.2 Indeed any crew member if so required by the commander is obliged to render assistance in restraining any person whom the commander is entitled to restrain. Note the references to the commander having *reasonable grounds to believe* …this imports an objective test in the sense that the commander must be judged as to his belief – the commander cannot simply assert a belief that it would not be reasonable to hold; *e.g. all young males who are scruffy, swarthy and unshaven are probably terrorists.*

4.4.3 All of this applies to any British-controlled aircraft whether registered in the UK or not. As can be seen, this section gives the commander very extensive powers indeed. As long as the commander reasonably believes that the person in question is about to do something that may jeopardize safety etc he can act - and can delegate other crew members, or - even other passengers, to act to prevent such things occurring.

4.4.4 Note also that the commander need only have reasonable grounds for his belief – proof is nowhere near a requirement. What are reasonable grounds cannot be defined but, in my opinion, it is not unreasonable to interpret that courts are likely to err strongly on the side of the commander and will not measure the commander’s actions with the benefit of hindsight. The commander is given a statutory right to disembark such a passenger in any country in which that aircraft may be.

4.4.5 Any restraint imposed on anyone (this could even include another crew member) on board an aircraft under the 1982 Act must not be continued after the time when the aircraft first ceases to be in flight. The time during which an aircraft is in flight includes (a) any further period from the moment when all external doors are closed following embarkation until the moment when any such door is opened for disembarkation; and (b) if the aircraft makes a forced landing, any period until the time when competent authorities of the country in which the forced landing takes place take over the responsibility for the aircraft and for the persons and property on board the aircraft. In the UK this means when an on-duty constable arrives at the place of landing.

4.4.6 The Act specifies that such a person must be handed over in the UK to the Police or to Immigration officers, but in the case of the rest of the World, to anyone carrying out functions that are broadly equivalent to UK Police or Immigration officers.

4.4.7 But the Act recognizes that the commander must be given the right to continue to restrain someone until handed over to the police or immigration authorities in the country where the aircraft lands.

4.4.8 As long as the commander notifies the relevant authorities of the country in which the aircraft ceases or will cease to be in flight as soon as reasonably possible that there is a person under restraint and why, the commander can keep that person restrained until he is given permission to hand that person over to those authorities.

4.4.9 Normally the person in question will be kept on board until collected by the authorities. So the key is to notify the authorities as soon as reasonably practicable that the commander has a person under restraint and to obtain a clear permission to hand the person over to the relevant authorities, when practicable, after arrival. For example, the commander may well decide to disembark all other passengers first and to keep the person under restraint until collected by the local police.

4.4.10 In addition the commander must report the fact of, and the reasons for, that disembarkation to— (i) an appropriate authority in the country of disembarkation; and (ii) the appropriate diplomatic or consular office of the country of nationality of that person. The latter is easier said than done if for example that person has destroyed all travel documents but hopefully the carrier will keep a record of nationality at check-in.

4.4.11 An issue that is not easy to resolve, save on a case-by-case basis, is when the commander’s responsibilities begin and end**.** The definition that appears in Article 155(1) of the Air Navigation Order 1995 is as follows “Commander' in relation to an aircraft means the member of the flight crew designated as commander of that aircraft by the operator, or, failing such a person, the person who is for the time being the pilot in command of the aircraft”;

4.4.12 The *US ‘Department of Defense’ Dictionary of Military and Associated Words*, defines aircraft commander as *“The aircrew member designated by competent authority as being in command of an aircraft and responsible for its safe operation and accomplishment of the assigned mission”.*

4.4.13 As can be seen, these definitions are relatively similar. In practical terms my view is that it is a question of fact to be determined on a case by case basis and that there must be a degree of proximity to the aircraft in question. For example, if a pilot arrives at crew HQ that happens to be a mile away from the particular aircraft that this pilot has been designated to command can it really be said that from that moment that pilot acquires all the rights and duties of an aircraft commander ? Surely not.

4.4.14 I think that for most purposes in commercial air transport the commanders responsibilities commence when he is in a position to exercise some form of dominion over the aircraft and this may be before he actually signs for the aircraft in question. This requires physical proximity to the aircraft. Once assuming command, this continues for all time until he relinquishes command and by some overt act expresses his intention so to do. For example, at a transit or refuelling stop, the mere fact the commander leaves the aircraft does not mean that he ceases to be the commander. When the commander signs off and then disembarks the command is at an end. But it is a fact sensitive enquiry that depends on the circumstances.

4.4.15 One thing that is certain is that governments continue to show an unlimited enthusiasm for ever more legislation, particularly since 1997. A period of grace, just to absorb what is already there, would be welcome.

## SECTION 5 – INTRODUCTION TO EUROPEAN LEGISLATION

This Section focuses on the Legal requirements that have to be met by an aircraft Captain as the pilot in command.

**The citing of legislation and guidance in this section is indicative of current requirements at the time of writing. Readers must consult 'Source' European Aviation Safety Agency (EASA) legislative documents to confirm recent amendment status.**

The European Union (EU) introduced EU-OPS regulations in July 2008. The regulations are derived from and are very similar to JAR-OPS 1 that was developed after consultations between the EU and JAA in 1997. 'EU-OPS' is the transposition of JAR-OPS 1 into EC law, to harmonise technical requirements and administrative procedures in the field of civil aviation. European Aviation Regulations of immediate interest to pilots are contained in the following documents:

EU-OPS 1: Commercial Air Transportation (Aeroplanes)
EU-OPS 2: Non-commercial operations with complex motor-powered aircraft
EU-OPS 3: Commercial Air Transportation (Helicopters)
EU-OPS 4: Aerial work & Corporate Aviation

EU-FCL 1: Flight crew licensing requirements for Aeroplane pilots
EU-FCL 2: Flight crew licensing requirements for Helicopter pilots
EU-FCL 3: Flight crew licensing Medical requirements
EU-FCL 4: Flight Crew Licensing (Flight Engineers)

Reference is made in OPS 1 to other JAR codes that have not yet been implemented, (e.g. JAR-FCL). Equivalent existing national regulations will continue to apply until such time as the referenced code has been implemented and incorporated in EASA Regulations.

A list of current JAA-JAR publications covering Operations, Licensing & Airworthiness inter alia, in addition to published EU-OPS legislation, may be found at: **http://www.jaat.eu/publications/status_documents.html**

### 5.1 AIRCRAFT COMMANDER' DUTIES, RESPONSIBILITIES & PREROGATIVES

Information contained in *So you want to be a Captain ?* is derived from EU-OPS 1. General guidance that is given for aircraft commanders is also applicable to pilots engaged in all flying operations and not only to fixed-wing Commercial Air Transportation addressed in this document.

Aircraft commanders and other aircraft crew members should be thoroughly conversant with Air Legislation requirements and be familiar with all the current requirements affecting aircraft operations, to ensure the legal and safe operation of a flight. In order to highlight particular areas of immediate concern to a captain, or specific to his responsibilities, selected text of interest is quoted. Duties and responsibilities of a Commander are highlighted in ***bold italics*** script, for ease of reference. Additional text in Normal font is included as supplementary background, to indicate other requirements of the particular Regulatory Article that the specific need-to-know material for commanders relates to; for interest and general information. **For the full text of the latest regulations, refer to a current copy of EU-OPS 1.**

All references made to ***men 'pilots in command'*** equally apply to ***lady 'pilots in command'.*** Hence, where ***he, him*** and ***his*** are mentioned, it is also intended to mean ***she, her*** and ***hers***.

Relevant Air Legislation quotes are extracts from EU-OPS 1 whose contents are listed in Appendix 10. To all intents and purposes, until consolidated into EASA-OPS and published under that banner, JAR-OPS 1, as amended, shall be read as being the EASA law to be applied to EU aircraft operations.

### 5.2 EASA LEGISLATION THAT REFERS – Selected items of specific interest to Captains only, so sequencing gaps exist. (Part /Sub-part and dedicated Section numbers shown are as listed in EU-OPS 1).

**EU-OPS 1 Sub Part B – GENERAL**

**EU-OPS 1.005 - General**

(a) An operator shall not operate an aeroplane for the purpose of commercial air transportation other than in accordance with EU-OPS Part 1. For operations of Performance Class B aeroplanes, alleviated requirements can be found in Appendix 1 to OPS 1.005(a).

**EU-OPS 1.065 - Carriage of weapons of war and munitions of war (See IEM OPS 1.065)**

(a) An operator shall not transport weapons of war and munitions of war by air unless an approval to do so has been granted by all States concerned.

(b) An operator shall ensure that weapons of war and munitions of war are:

(1) Stowed in the aeroplane in a place which is inaccessible to passengers during flight; and

(2) In the case of firearms, unloaded, unless, before the commencement of the flight, approval has been granted by all States concerned that such weapons of war and munitions of war may be carried in circumstances that differ in part or in total from those indicated in this sub-paragraph.

(c) ***An operator shall ensure that the commander is notified before a flight begins of the details and location on board the aeroplane of any weapons of war and munitions of war intended to be carried.***

**EU-OPS 1.070 - Carriage of sporting weapons and ammunition (See IEM OPS 1.070)**

(a) An operator shall take all reasonable measures to ensure that any sporting weapons intended to be carried by air are reported to him.

(b) An operator accepting the carriage of sporting weapons shall ensure that they are:

(1) Stowed in the aeroplane in a place which is inaccessible to passengers during flight unless the Authority has determined that compliance is impracticable and has accepted that other procedures might apply; and

(2) In the case of firearms or other weapons that can contain ammunition, unloaded.

(c) Ammunition for sporting weapons may be carried in passengers' checked baggage, subject to certain limitations, in accordance with the Technical Instructions (see OPS 1.1160(b)(5)) as defined in OPS 1.1150(a)(15).

**EU-OPS 1.075 - Method of carriage of persons**

(a) An operator shall take all reasonable measures to ensure that no person is in any part of an aeroplane in flight which is not a part designed for the accommodation of persons ***unless temporary access has been granted by the commander to any part of the aeroplane:***

(1) For the purpose of taking action necessary for the safety of the aeroplane or of any person, animal or goods therein; or

(2) In which cargo or stores are carried, being a part which is designed to enable a person to have access thereto while the aeroplane is in flight.

**EU-OPS 1.085 - Crew responsibilities** (also see ACJ OPS 1.085(e)(3))

(b) A crew member shall:

(1) ***Report to the commander any fault, failure, malfunction or defect which he/she believes may affect the airworthiness or safe operation of the aeroplane including emergency systems.***

(2) ***Report to the commander any incident that endangered, or could have endangered, the safety of operation; and***

(3) ***Make use of the operator's occurrence reporting schemes in accordance with OPS 1.037(a)(2). In all such cases, a copy of the report(s) shall be communicated to the commander concerned.***

(f) ***The commander shall***

(1) ***Be responsible for the safety of all crew members, passengers and cargo on board, as soon as he arrives on board, until he/she leaves the aeroplane at the end of the flight;***

(2) ***Be responsible for the operation and safety of the aeroplane from the moment the aeroplane is first ready to move for the purpose of taxiing prior to take-off until the moment it finally comes to rest at the end of the flight and the engine(s) used as primary propulsion units are shut down;***

(3) ***Have authority to give all commands he/she deems necessary for the purpose of securing the safety of the aeroplane and of persons or property carried therein;***

(4) ***Have authority to disembark any person, or any part of the cargo, which, in his opinion, may represent a potential hazard to the safety of the aeroplane or its occupants;***

(5) ***Not allow a person to be carried in the aeroplane who appears to be under the influence of alcohol or drugs to the extent that the safety of the aeroplane or its occupants is likely to be endangered;***

(6) ***Have the right to refuse transportation of inadmissible passengers, deportees or persons in custody if their carriage poses any risk to the safety of the aeroplane or its occupants;***

(7) ***Ensure that all passengers are briefed on the location of emergency exits and the location and use of relevant safety and emergency equipment;***

(8) ***Ensure that all operational procedures and check lists are complied with in accordance with the Operations Manual;***

(9) ***Not permit any crew member to perform any activity during take-off, initial climb, final approach and landing except those duties required for the safe operation of the aeroplane.***

(10) ***Not permit:***

(i) ***A flight data recorder to be disabled, switched off or erased during flight, nor permit recorded data to be erased after flight in the event of an accident or an incident subject to mandatory reporting;***

(ii) ***A cockpit voice recorder to be disabled or switched off during flight unless he/she believes that the recorded data, which otherwise would be erased automatically, should be preserved for incident or accident investigation nor permit recorded data to be manually erased during or after flight in the event of an accident or an incident subject to mandatory reporting;***

(11) ***Decide whether or not to accept an aeroplane with unserviceabilities allowed by the CDL or MEL; and***

(12) ***Ensure that the pre-flight inspection has been carried out.***

(g) ***The commander or the pilot to whom conduct of the flight has been delegated shall, in an emergency situation that requires immediate decision and action, take any action he/she considers necessary under the circumstances. In such cases he/she may deviate from rules, operational procedures and methods in the interest of safety.***

**EU-OPS 1.090 - Authority of the commander**

An operator shall take all reasonable measures to ensure that all persons carried in the aeroplane obey all lawful commands given by the commander for the purpose of securing the safety of the aeroplane and of persons or property carried therein.

**EU-OPS 1.100 - Admission to flight deck**

(a) An operator must ensure that no person, other than a flight crew member assigned to a flight, is admitted to, or carried in, the flight deck unless that person is:

(1) An operating crew member;

(2) A representative of the Authority responsible for certification, licensing or inspection if this is required for the performance of his official duties; or

(3) Permitted by, and carried in accordance with instructions contained in the Operations Manual.

(b) **The commander shall ensure that:**

(1) ***In the interests of safety, admission to the flight deck does not cause distraction and/or interfere with the flight's operation; and***

(2) ***All persons carried on the flight deck are made familiar with the relevant safety procedures.***

(c) ***The final decision regarding the admission to the flight deck shall be the responsibility of the commander.***

**EU-OPS 1.100 - Appendix to Admission to the flight deck:**

An operator must establish rules for the carriage of passengers in a pilot seat. ***The commander must ensure that the Carriage of passengers in a pilot seat does not cause distraction and/or interference with the operation of the flight; and that the passenger occupying a pilot seat is made familiar with the relevant restrictions and safety procedures.*** (**Editor's Note:** Other than as permitted in (a) above, no other passengers are currently allowed on the flight deck, for security reasons).

**EU-OPS 1.125 - Documents to be carried (See Appendix 1 to EU-OPS 1.125)**

(a) An operator shall ensure that the following are carried on each flight:

(1) The Certificate of Registration.

(2) The Certificate of Airworthiness.

(3) The original or a copy of the Noise Certificate (if applicable)[, including an English translation, where one has been provided by the Authority responsible for issuing the noise certificate.

(4) The original or a copy of the Air Operator Certificate.

(5) The Aircraft Radio Licence.

(6) The original or a copy of the Third party liability Insurance Certificate(s).

(b) Each flight crew member shall, on each flight, carry a valid flight crew licence with appropriate rating(s) for the purpose of the flight.

**EU-OPS 1.130 - Manuals to be carried**

An operator shall ensure that:

(1) The current parts of the Operations Manual relevant to the duties of the crew are carried on each flight;

(2) Those parts of the Operations Manual which are required for the conduct of a flight are easily accessible to the crew on board the aeroplane; and

(3) The current Aeroplane Flight Manual is carried in the aeroplane unless the Authority has accepted that the Operations Manual prescribed in OPS 1.1045, Appendix 1, Part B contains relevant information for that aeroplane.

**EU-OPS 1.135 - Additional information and forms to be carried**

(a) An operator shall ensure that, in addition to the documents and manuals prescribed in OPS 1.125 & OPS 1.130, the following information and forms, relevant to the type and area of operation, are carried on each flight:

(1) Operational Flight Plan containing at least the information required in OPS 1.1060;

(2) Aeroplane Technical Log containing at least the information required in Part M – M.A.306 Operator's technical log system;

(3) Details of the filed ATS flight plan;

(4) Appropriate NOTAM / AIS briefing documentation;

(5) Appropriate meteorological information;

(6) Mass and balance documentation as specified in Subpart J;

(7) Notification of special categories of passenger such as security personnel, if not considered as crew, handicapped persons, inadmissible passengers, deportees and persons in custody;

(8) Notification of special loads including dangerous goods including written information to the commander as prescribed in OPS 1.1215(c);

(9) Current maps and charts and associated documents as prescribed in OPS 1.290(b)(7);

(10) Any other documentation which may be required by the States concerned with this flight, such as cargo manifest, passenger manifest etc; and

(11) Forms to comply with the reporting requirements of the Authority and the operator.

(b) The Authority may permit the information detailed in sub-paragraph (a) above, or parts thereof, to be presented in a form other than on printed paper. An acceptable standard of accessibility, usability and reliability must be assured.

**EU-OPS 1.140 - Information retained on the ground**

(a) An operator shall ensure that:

(1) At least for the duration of each flight or series of flights;

(i) Information relevant to the flight and appropriate for the type of operation is preserved on the ground; and

(ii) The information is retained until it has been duplicated at the place at which it will be stored in accordance with OPS 1.1065; or, if this is impracticable,

(iii) The same information is carried in a fireproof container in the aeroplane.

(b) The information referred to in subparagraph (a) above includes:

(1) A copy of the operational flight plan where appropriate;

(2) Copies of the relevant part(s) of the aeroplane technical log;

(3) Route specific NOTAM documentation if specifically edited by the operator;

(4) Mass and balance documentation if required (OPS 1.625 refers); and

(5) Special loads notification.

**EU-OPS 1.145 - Power to inspect**

An operator shall ensure that any person authorised by the Authority is permitted at any time to board and fly in any aeroplane operated in accordance with an AOC issued by that Authority and to enter and remain on the flight deck provided that ***the commander may refuse access to the flight deck if, in his opinion, the safety of the aeroplane would thereby be endangered.***

**EU-OPS 1.150 - Production of documentation and records**

(a) An operator shall:

(1) Give any person authorised by the Authority access to any documents and records which are related to flight operations or maintenance; and

(2) Produce all such documents and records, when requested to do so by the Authority, within a reasonable period of time.

(b) ***The commander shall, within a reasonable time of being requested to do so by a person authorised by an Authority, produce to that person the documentation required to be carried on board.***

**EU-OPS 1 Sub Part C – OPERATOR CERTIFICATION AND SUPERVISION**

**EU–OPS 1.175 - General rules for Air Operator Certification**

(a) An operator shall not operate an aeroplane for the purpose of commercial air transportation otherwise than under, and in accordance with, the terms and conditions of an Air Operator Certificate (AOC).

**EU-OPS 1 Sub Part D – OPERATIONAL PROCEDURES**

**EU-OPS - 1.230 Instrument departure and approach procedures**

(a) An operator shall ensure that instrument departure and approach procedures established by the State in which the aerodrome is located are used.

(b) ***Notwithstanding sub-paragraph (a) above, a commander may accept an ATC clearance to deviate from a published departure or arrival route, provided obstacle clearance criteria are observed and full account is taken of the operating conditions. The final approach must be flown visually or in accordance with the established instrument approach procedure.***

**EU-OPS 1.255 - Fuel policy (see Section 7 in this Part 2 LEGAL for an expanded description)**
(also See Appendix 1 to OPS 1.255 & Appendix 2 to OPS 1.255) & ACJ OPS 1.255)

(a) An operator must establish a fuel policy for the purpose of flight planning and in-flight replanning to ensure that every flight carries sufficient fuel for the planned operation and reserves to cover deviations from the planned operation.

(b) An operator shall ensure that the planning of flights is at least based upon (1) and (2) below:

(1) Procedures contained in the Operations Manual and data derived from:

(i) Data provided by the aeroplane manufacturer; or
(ii) Current aeroplane specific data derived from a fuel consumption monitoring system.

(2) The operating conditions under which the flight is to be conducted including:
(i) Realistic aeroplane fuel consumption data;
(ii) Anticipated masses;
(iii) Expected meteorological conditions; and
(iv) Air Navigation Services Provider(s) procedures and restrictions.

(c) An operator shall ensure that the pre-flight calculation of usable fuel required for a flight includes:

(1) Taxi fuel;

(2) Trip fuel;

(3) Reserve fuel consisting of:
(i) Contingency fuel;
(ii) Alternate fuel, if a destination alternate aerodrome is required. (This does not preclude selection of the departure aerodrome as the destination alternate aerodrome);
(iii) Final reserve fuel;
(iv) Additional fuel, if required by the type of operation (e.g. ETOPS); and

(4) ***Extra fuel if required by the commander***.

(d) An operator shall ensure that in-flight replanning procedures for calculating usable fuel required when a flight has to proceed along a route or to a destination aerodrome other than originally planned includes:

(1) Trip fuel for the remainder of the flight;

(2) Reserve fuel consisting of:
(i) Contingency fuel;
(ii) Alternate fuel, if a destination alternate aerodrome is required. (This does not preclude selection of the departure aerodrome as the destination alternate [aerodrome);
(iii) Final reserve fuel; and
(iv) Additional fuel, if required by the type of operation (e.g. ETOPS); and

(3) ***Extra fuel if required by the commander.***

**EU-OPS 1.260 - Carriage of Persons with Reduced Mobility (PRM)** (See IEM OPS 1.260 )

(a) An operator shall establish procedures for the carriage of Persons with Reduced Mobility (PRMs).

(b) An operator shall ensure that PRMs are not allocated, nor occupy, seats where their presence could

(1) Impede the crew in their duties;

(2) Obstruct access to emergency equipment; or

(3) Impede the emergency evacuation of the aeroplane.

(c) ***The commander must be notified when PRMs are to be carried on board*.**

**EU-OPS 1.265 - Carriage of inadmissible passengers, deportees or persons in custody**

An operator shall establish procedures for the transportation of inadmissible passengers, deportees or persons in custody to ensure the safety of the aeroplane and its occupants. ***The commander must be notified when the above-mentioned persons are to be carried on board.***

**EU–OPS 1.270 - Stowage of baggage and cargo**
(See Appendix 1 to OPS 1.270 & AMC OPS 1.270)

(a) An operator shall establish procedures to ensure that only such hand baggage is taken into the passenger cabin as can be adequately and securely stowed.

(b) An operator shall establish procedures to ensure that all baggage and cargo on board, which might cause injury or damage, or obstruct aisles and exits if displaced, is placed in stowages designed to prevent movement.

**EU-OPS 1.285 - Passenger briefing** (See source document for expanded details)

(a) General.

(1) Passengers are given a verbal briefing about safety matters. Parts or all of the briefing may be provided by an audio-visual presentation.

(b) Before take-off

(c) After take-off

(d) Before landing

(e) After landing

**EU-OPS 1.290 - Flight preparation**

(a) An operator shall ensure that an operational flight plan is completed for each intended flight.

(b) ***The commander shall not commence a flight unless he is satisfied that:***

(1) ***The aeroplane is airworthy;***

(2) ***The aeroplane is not operated contrary to the provisions of the Configuration Deviation List (CDL);***

(3) ***The instruments and equipment required for the flight to be conducted, in accordance with Subparts K and L, are available;***

(4) ***The instruments and equipment are in operable condition except as provided in the MEL;***

(5) ***Those parts of the operations manual which are required for the conduct of the flight are available;***

(6) ***The documents, additional information and forms required to be available by OPS 1.125 and OPS 1.135 are on board;***

(7) ***Current maps, charts and associated documentation or equivalent data are available to cover the intended operation of the aeroplane including any diversion which may reasonably be expected. This shall include any conversion tables necessary to support operations where metric heights, altitudes and flight levels must be used;***

(8) ***Ground facilities and services required for the planned flight are available and adequate;***

(9) ***The provisions specified in the operations manual in respect of fuel, oil and oxygen requirements, minimum safe altitudes, aerodrome operating minima and availability of alternate aerodromes, where required, can be complied with for the planned flight;***

(10) ***The load is properly distributed and safely secured;***

(11) ***The mass of the aeroplane, at the commencement of take-off roll, will be such that the flight can be conducted in compliance with Subparts F to I as applicable; and***

(12) ***Any operational limitation in addition to those covered by sub-paragraphs (9) and (11) above can be complied with.***

**EU-OPS 1.295 - Selection of aerodromes** (For expanded details refer to source document)

(a) An operator shall establish procedures for the selection of destination and/or alternate aerodromes in accordance with OPS 1.220 when planning a flight.

(b) An operator must select and specify in the operational flight plan a take-off alternate aerodrome if it would not be possible to return to the departure aerodrome for meteorological or performance reasons.

**EU-OPS 1.297 - Planning minima for IFR flights**

(a) Planning minima for take-off alternates. An operator shall not select an aerodrome as a take-off alternate aerodrome unless the appropriate weather reports or forecasts or any combination thereof indicate that, during a period commencing 1 hour before and ending 1 hour after the estimated time of arrival at the aerodrome, the weather conditions will be at or above the applicable landing minima specified in accordance with OPS 1.225. The ceiling must be taken into account when the only approaches available are non-precision and/or circling approaches. Any limitation related to one-engine-inoperative operations must be taken into account.

(b) Planning minima for destination and destination alternate aerodromes. An operator shall only select the destination aerodrome and/or destination alternate aerodrome(s) when the appropriate weather reports or forecasts, or any combination thereof, indicate that, during a period commencing 1 hour before and ending 1 hour after the estimated time of arrival at the aerodrome, the weather conditions will be at or above the applicable planning minima as follows:

(1) Planning minima for a destination aerodrome except isolated destination aerodromes:

(i) RVR/visibility specified in accordance with OPS 1.225; and

(ii) For a non-precision approach or a circling approach, the ceiling at or above MDH; and

(2) Planning minima for destination alternate aerodrome(s) and isolated destination aerodromes will be in accordance with Table 1 below:

Table 1 **- Planning minima — En-route and destination alternates — Isolated destination aerodromes**

| Type of approach | Planning Minima |
|---|---|
| Cat II and III | Cat I (*Note 1*) |
| Cat I Non-precision | Non-precision - (*Notes 1 and 2*) |
| Non-precision | Non-precision<br>(*Notes 1 and 2*) plus 200 ft/1,000 m |
| Circling | Circling (*Notes 2 and 3*) |
| *Note 1:* RVR.<br>*Note 2:* The ceiling must be at or above the MDH.<br>*Note 3:* Visibility. | |

(c) Planning minima for an en-route alternate aerodrome. An operator shall not select an aerodrome as an en-route alternate aerodrome unless the appropriate weather reports or forecasts, or any combination thereof, indicate that, during a period commencing 1 hour before and ending 1 hour after the expected time of arrival at the aerodrome, the weather conditions will be at or above the planning minima in accordance with Table 1 above.

Table 2 - **Planning minima — ETOPS**

| **Type of Approach** | **Planning Minima** | |
|---|---|---|
| | **(RVR/visibility required & ceiling if applicable)** | |
| | **AERODROME WITH** | |
| | at least 2 separate approach procedures based on 2 separate aids serving 2 separate runways | at least 2 separate approach procedures based on 2 separate aids serving 1 runway; or,<br>at least 1 approach procedure based on 1 aid serving 1 runway |
| Precision Approach<br>Cat II, III (ILS, MLS) | Precision Approach Cat I Minima | Non-Precision Approach Minima |
| Precision Approach Cat I<br>(ILS, MLS) | Non-Precision approach Minima | Circling Minima or, if not available, Non-Precision Approach minima plus<br>200 ft/1,000 m |
| Non-Precision Approach | The lower of Non-Precision Approach minima plus 200 ft/ 1,000 m or circling minima | The higher of circling minima or Non- Precision Approach minima plus 200 ft/1,000 m |
| Circling Approach | Circling minima | |

**EU-OPS 1.300 - Submission of ATS Flight Plan** (See AMC OPS 1.300)

**EU–OPS 1.305 - Refuelling/Defuelling with passengers embarking, on board or disembarking**
(See Appendix 1 to EU-OPS 1.305) & (See IEM OPS 1.305)

**EU-OPS 1.307 - Refuelling/Defuelling with wide-cut fuel** (See IEM OPS 1.307)

**EU-OPS 1.308 - Push back and Towing** (See ACJ OPS 1.308)

**EU-OPS 1.310 - Crew Members at stations**

(a) Flight crew members

(1) During take-off and landing each flight crew member required to be on flight deck duty shall be at his station.

(2) During all other phases of flight each flight crew member required to be on flight deck duty shall remain at his station unless his absence is necessary for the performance of his duties in connection with the operation, or for physiological needs, provided at least one suitably qualified pilot remains at the controls of the aeroplane at all times.

(3) During all phases of flight each flight crew member required to be on flight deck duty shall remain alert. If a lack of alertness is encountered, appropriate countermeasures shall be used***. If unexpected fatigue is experienced, a controlled rest procedure, organised by the commander, can be used if workload permits*** (see ACJ OPS 1.310(a)(3)). Controlled rest taken in this way may never be considered to be part of a rest period for purposes of calculating flight time limitations nor used to justify any duty period.

(b) Cabin crew members. On all the decks of the aeroplane that are occupied by passengers, required cabin crew members shall be seated at their assigned stations during critical phases of flight. (See IEM OPS 1.310(b))

**EU-OPS 1.313 - Use of headset**

(a) Each flight crew member required to be on flight deck duty shall wear the headset with boom microphone or equivalent required by EU-OPS 1.650(p) and/or 1.652(s) and use it as the primary device to listen to the voice communications with Air Traffic Services:

(1) On the ground:

(i) When receiving the ATC departure clearance via voice communication,

(ii) When engines are running,

(2) In flight below transition altitude or 10,000 feet, whichever is higher, and

(3) ***Whenever deemed necessary by the commander.***

(b) In the conditions of paragraph (a) above, the boom microphone or equivalent shall be in a position which permits its use for two-way radio communications.

**EU-OPS 1.315 - Assisting means for emergency evacuation**

An operator shall establish procedures to ensure that before taxiing, take-off and landing, and when safe and practicable to do so, an assisting means for emergency evacuation that deploys automatically, is armed.

**EU-OPS 1.320 - Seats, safety belts and harnesses**

(a) Crew members

(1) During take-off and landing, **and whenever deemed necessary by the commander** in the interest of safety, each crew member shall be properly secured by all safety belts and harnesses provided.

(2) During other phases of the flight each flight crew member on the flight deck shall keep his safety belt fastened while at his station.

(b) Passengers

(1) Before take-off and landing, and during taxiing, and whenever deemed necessary in the interest of safety, ***the commander shall ensure that each passenger on board occupies a seat or berth with his safety belt, or harness where provided, properly secured.***

(2) An operator shall make provision for, ***and the commander shall ensure that multiple occupancy of aeroplane seats may only be allowed on specified seats and does not occur other than by one adult and one infant who is properly secured by a supplementary loop belt or other restraint device.***

**EU-OPS 1.325 - Securing of passenger cabin and galley(s)**

(a) An operator shall establish procedures to ensure that before taxiing, take-off and landing all exits and escape paths are unobstructed.

(b) ***The commander shall ensure that before take-off and landing, and whenever deemed necessary in the interest of safety, all equipment and baggage is properly secured.***

**EU–OPS 1.330 - Accessibility of emergency equipment**

***The commander shall ensure that relevant emergency equipment remains easily accessible for immediate use.***

**EU–OPS 1.335 - Smoking on board**

(a) ***The commander shall ensure that no person on board is allowed to smoke:***

(1) ***Whenever deemed necessary in the interest of safety;***

(2) ***While the aeroplane is on the ground unless specifically permitted in accordance with procedures defined in the Operations Manual;***

(3) ***Outside designated smoking areas, in the aisle(s) and in the toilet(s);***

(4) ***In cargo compartments and/or other areas where cargo is carried which is not stored in flame resistant containers or covered by flame resistant canvas; and***

(5) ***In those areas of the cabin where oxygen is being supplied.***

**EU–OPS 1.340 - Meteorological Conditions**

(a) ***On an IFR flight a commander shall not:***

(1) ***Commence take-off; nor***

(2) ***Continue beyond the point from which a revised flight plan applies in the event of in-flight re-planning, unless information is available indicating that the expected weather conditions, at the at the destination and/or required alternate aerodrome(s) prescribed in OPS 1.295 are at or above the planning minima, prescribed in OPS 1.297.***

(b) ***On an IFR flight, a commander shall not continue towards the planned destination aerodrome unless the latest information available indicates that, at the expected time of arrival, the weather conditions at the destination, or at least one destination alternate aerodrome, are at or above the applicable aerodrome operating minima.***

(c) ***On an IFR flight, a commander shall not continue towards the planned destination aerodrome unless the latest information available indicates that, at the expected time of arrival, the weather conditions at the destination, or at least one destination alternate aerodrome, are at or above the planning applicable aerodrome operating minima.***

(d) ***On a VFR flight a commander shall not commence take-off unless current meteorological reports or a combination of current reports and forecasts indicate that the meteorological conditions along the route or that part of the route to be flown under VFR will, at the appropriate time, be such as to render compliance with these rules possible.***

**EU–OPS 1.345 - Ice and other contaminants – ground procedures -** (See ACJ OPS 1.345)

(a) An operator shall establish procedures to be followed when ground de-icing and anti-icing and related inspections of the aeroplane(s) are necessary.

(b) ***A commander shall not commence take-off unless the external surfaces are clear of any deposit which might adversely affect the performance and/or controllability of the aeroplane except as permitted in the Aeroplane Flight Manual.***

**EU–OPS 1.346 - Ice and other contaminants – flight procedures**

(a) An operator shall establish procedures for flights in expected or actual icing conditions. (See ACJ OPS 1.346 and OPS 1.675).

(b) ***A commander shall not commence a flight nor intentionally fly into expected or actual icing conditions unless the aeroplane is certificated and equipped to cope with such conditions.***

**EU–OPS 1.346 - Ice and other contaminants — flight procedures**

(a) An operator shall establish procedures for flights in expected or actual icing conditions.

(b) ***A commander shall not commence a flight nor intentionally fly into expected or actual icing conditions unless the aeroplane is certificated and equipped to cope with such conditions***.

**EU–OPS 1.350 - Fuel and oil supply**

***A commander shall not commence a flight unless he/she is satisfied that the aeroplane carries at least the planned amount of fuel and oil to complete the flight safely, taking into account the expected operating conditions.***

**EU-OPS 1.355 - Take-off conditions**

***Before commencing take-off, a commander must satisfy himself/herself that, according to the information available to him/her, the weather at the aerodrome and the condition of the runway intended to be used should not prevent a safe take-off and departure.***

**EU-OPS 1.360 - Application of take-off minima**

***Before commencing take-off, a commander must satisfy himself/herself that the RVR or visibility in the takeoff direction of the aeroplane is equal to or better than the applicable minimum.***

**EU-OPS 1.365 - Minimum flight altitudes** (See IEM OPS 1.250)

***The commander or the pilot to whom conduct of the flight has been delegated shall not fly below specified minimum altitudes except when necessary for take-off or landing.***

**EU-OPS 1.370 - Simulated abnormal situations in flight**

An operator shall establish procedures to ensure that abnormal or emergency situations requiring the application of part or all of abnormal or emergency procedures and simulation of IMC by artificial means are not simulated during commercial air transportation flights.

**EU-OPS 1.375 - In-flight fuel management (**See Appendix 1 to Ops 1.375)

(a) An operator must establish a procedure to ensure that in-flight fuel checks and fuel management are carried out

(b) ***A commander shall ensure that the amount of usable fuel remaining in flight is not less than the fuel required to proceed to an aerodrome where a safe landing can be made, with final reserve fuel remaining.***

(c) ***The commander shall declare an emergency when calculated usable fuel on landing is less than final reserve fuel.***

**Appendix 1 to Ops 1.375 - In-flight fuel management**

(a) In-flight fuel checks:

(1) ***A commander must ensure that fuel checks are carried out in flight at regular intervals. The remaining fuel must be recorded and evaluated to:***

***(i) Compare actual consumption with planned consumption;***

***(ii) Check that the remaining fuel is sufficient to complete the flight; and***

***(iii) Determine the expected fuel remaining on arrival at the destination.***

(2) ***The relevant fuel data must be recorded.***

(b) In-flight fuel management.

(1) If, as a result of an in-flight fuel check, the calculated fuel remaining on arrival at the destination is less than the required alternate fuel plus final reserve fuel, the commander must take into account the traffic and the operational conditions prevailing at the destination aerodrome, along the diversion route to an alternate aerodrome and at the destination alternate aerodrome, in order to decide to proceed to the destination aerodrome or to divert, so as to land with not less than final reserve fuel.

(2) On a flight to an isolated aerodrome: The last possible point of diversion to any available en-route alternate aerodrome shall be determined. Before reaching this point, the commander shall assess the fuel expected to remain overhead the isolated aerodrome, the weather conditions, and the traffic and operational conditions prevailing at the isolated aerodrome and at any of the en-route aerodromes before deciding whether to proceed to the isolated aerodrome or to divert to an en-route aerodrome.

**EU-OPS 1.385 - Use of supplemental oxygen**

***A commander shall ensure that flight crew members engaged in performing duties essential to the safe operation of an aeroplane in flight use supplemental oxygen continuously whenever cabin altitude exceeds 10,000 ft for a period in excess of 30 minutes and whenever the cabin altitude exceeds 13,000 feet.***

**EU-OPS 1.390 - Cosmic radiation**

(a) An operator shall take account of the in flight exposure to cosmic radiation of all crew members while on duty (including positioning) and shall take the following measures for those crew liable to be subject to exposure of more than 1 mSv per year (See ACJ OPS 1.390(a)(1));

(1) Assess their exposure

(2) Take into account the assessed exposure when organising working schedules with a view to reduce the doses of highly exposed crew members (See ACJ OPS 1.390(a)(2));

(3) Inform the crew members concerned of the health risks their work involves (See ACJ OPS 1.390(a)(3));

(4) Ensure that the working schedules for female crew members, once they have notified the operator that they are pregnant, keep the equivalent dose to the foetus as low as can reasonably be achieved and in any case ensure that the dose does not exceed 1 mSv for the remainder of the pregnancy;

(5) Ensure that individual records are kept for those crew members who are liable to high exposure. These exposures are to be notified to the individual on an annual basis, and also upon leaving the operator.

(b) Flight above 15,000m (49,000 ft)

(1) An operator shall not operate an aeroplane above 15,000m (49,000 ft) unless the equipment specified in OPS 1.680(a)(1) is serviceable, or the procedure prescribed in OPS 1.680(a)(2) is complied with. **[Editor's note:** refers to radiation exposure]

(2) ***The commander or the pilot to whom conduct of the flight has been delegated shall initiate a descent as soon as practicable when the limiting values of cosmic radiation dose rate specified in the Operations Manual are exceeded.*** **(**See EU-OPS 1.680(a)(1)). [**Editors' note:** re radiation exposure]

**EU-OPS 1.395 - Ground proximity detection**

When undue proximity to the ground is detected by any flight crew member or by a ground proximity warning system, ***the commander or the pilot to whom conduct of the flight has been delegated shall ensure that corrective action is initiated immediately to establish safe flight conditions.***

**EU-OPS 1.398 - Use of Airborne Collision Avoidance System (ACAS) (See ACJ OPS 1.398)**

An operator shall establish procedures to ensure that:

(a) When ACAS is installed and serviceable, it shall be used in flight in a mode that enables Resolution Advisories (RA) to be produced unless to do so would not be appropriate for conditions existing at the time.

(b) When undue proximity to another aeroplane (RA) is detected by ACAS***, the commander or the pilot to whom conduct of the flight has been delegated must ensure that any corrective action indicated by the RA is initiated immediately, unless doing so would jeopardize the safety of the aeroplane;*** the corrective action must:

(i) Never be in a sense opposite to that indicated by the RA

(ii) Be in the correct sense indicated by the RA even if this is in conflict with the vertical element of an ATC instruction.

(iii) Be the minimum possible to comply with the RA indication.

(c) Prescribed ACAS ATC communications are specified.

(d) When the conflict is resolved the aeroplane is promptly returned to the terms of the ATC instructions or clearance.

**EU-OPS 1.400 - Approach and landing conditions** (See IEM OPS 1.400)

Before commencing an approach to land, ***the commander must satisfy himself/herself that, according to the information available to him/her, the weather at the aerodrome and the condition of the runway intended to be used should not prevent a safe approach, landing or missed approach, having regard to the performance information contained in the Operations Manual.***

**EU-OPS 1.405 - Commencement and continuation of approach**

(a) ***The commander or the pilot to whom conduct of the flight has been delegated may commence an instrument approach regardless of the reported RVR/Visibility but the approach shall not be continued beyond the outer marker, or equivalent position, if the reported RVR/visibility is less than the applicable minima.*** **(See [AR-OPS 1.192.)**

(b) Where RVR is not available, RVR values may be derived by converting the reported visibility in accordance with Appendix 1 to EU-OPS 1.430, sub-paragraph (h).

(c) If, after passing the outer marker or equivalent position in accordance with (a) above, the reported VR/visibility falls below the applicable minimum, the approach may be continued to DA/H or MDA/H.

(d) Where no outer marker or equivalent position exists, the commander or the pilot to whom conduct of the flight has been delegated shall make the decision to continue or abandon the approach before descending below 1,000 ft above the aerodrome on the final approach segment. If the MDA/H is at or above 1,000 ft above the aerodrome, the operator shall establish a height, for each approach procedure, below which the approach shall not be continued if the RVR/visibility is less than the applicable minima.

(e) The approach may be continued below DA/H or MDA/H and the landing may be completed provided that the required visual reference is established at the DA/H or MDA/H and is maintained.

(f) The touch-down zone RVR is always controlling. If reported and relevant, the mid point and stop end RVR are also controlling. The minimum RVR value for the mid-point is 125m or the RVR required for the touch-down zone if less, and 75m for the stop-end. For aeroplanes equipped with a roll-out guidance or control system, the minimum RVR value for the mid-point is 75m. Note. “Relevant”, in this context, means that part of the runway used during the high speed phase of the landing down to a speed of approximately 60 knots.

**EU-OPS 1.410 - Operating procedures – Threshold crossing height**

An operator must establish operational procedures designed to ensure that an aeroplane being used to conduct precision approaches crosses the threshold by a safe margin, with the aeroplane in the landing configuration and attitude.

**EU-OPS 1.415 - Journey log**

***A commander shall ensure that the Journey log is completed.***

**EU-OPS 1.420 - Occurrence reporting**

(a) *Terminology*

(1) *Incident.* An occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation.

(2) *Serious Incident.* An incident involving circumstances indicating that an accident nearly occurred.

(3) *Accident.* An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all persons have disembarked, in which:

(i) A person is fatally or seriously injured as a result of:

(A) Being in the aircraft;

(B) Direct contact with any part of the aircraft, including parts which have become detached from the aircraft; or,

(C) Direct exposure to jet blast; except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew: or

(ii) the aircraft sustains damage or structural failure which adversely affects the structural strength, performance or flight characteristics of the aircraft; and would normally require major repair or replacement of the affected component; except for engine failure or damage, when the damage is limited to the engine, its cowlings or accessories; or for damage limited to propellers, wing tips, antennas, tyres, brakes, fairings, small dents or puncture holes in the aircraft skin: or

(iii) the aircraft is missing or is completely inaccessible.

(b) Incident Reporting.

An operator shall establish procedures for reporting incidents taking into account responsibilities described below and circumstances described in sub-paragraph (d) below.

(1) OPS 1.085(b) specifies the responsibilities of crew members for reporting incidents that endanger, or could endanger, the safety of operation.

(2) ***The commander or the operator of an aeroplane shall submit a report to the Authority of any incident that endangers or could endanger the safety of operation.***

(3) ***Reports must be despatched within 72 hours of the time when the incident was identified unless exceptional circumstances prevent this.***

(4) ***A commander shall ensure that all known or suspected technical defects and all exceedances of technical limitations occurring while he/she was responsible for the flight are recorded in the aircraft technical log. If the deficiency or exceedance of technical limitations endangers or could endanger the safety of operation, the commander must in addition initiate the submission of a report to the Authority in accordance with paragraph (b)(2) above.***

(5) In the case of incidents reported in accordance with sub- paragraphs (b)(1), (b)(2) and (b)(3) above, arising from, or relating to, any failure, malfunction or defect in the aeroplane, its equipment or any item of ground support equipment, or which cause or might cause adverse effects on the continuing airworthiness of the aeroplane, the operator must also inform the organisation responsible for the design or the supplier or, if applicable, the organisation responsible for continued airworthiness, at the same time as a report is submitted to the Authority.

(c) Accident and Serious Incident Reporting.

An operator shall establish procedures for reporting accidents and serious incidents taking into account responsibilities described below and circumstances described in sub-paragraph (d) below.

(1) ***A commander shall notify the operator of any accident or serious incident occurring while he/she was responsible for the flight. In the event that the commander is incapable of providing such notification, this task shall be undertaken by any other member of the crew if they are able to do so, note being taken of the succession of command specified by the operator.***

(2) An operator shall ensure that the Authority in the State of the operator, the nearest appropriate Authority (if not the Authority in the State of the operator), and any other organisation required by the State of the operator to be informed, are notified by the quickest means available of any accident or serious incident and - in the case of accidents only - at least before the aeroplane is moved unless exceptional circumstances prevent this.

(3) ***The commander or the operator of an aeroplane shall submit a report to the Authority in the State of the operator within 72 hours of the time when the accident or serious incident occurred.***

(d) Specific Reports. Occurrences for which specific notification and reporting methods must be used are described below;

(1) *Air Traffic Incidents.* ***A commander shall without delay notify the air traffic service unit concerned of the incident and shall inform them of his intention to submit an air traffic incident report after the flight has ended whenever an aircraft in flight has been endangered by:***

(i) A near collision with any other flying device;

(ii) Faulty air traffic procedures or lack of compliance with applicable procedures by air traffic services or by the flight crew;

(iii) Failure of air traffic services facilities.

***In addition, the commander shall notify the Authority of the incident.***

(2) *Airborne Collision Avoidance System Resolution Advisory*. A commander shall notify the air traffic service unit concerned and submit an ACAS report to the Authority whenever an aircraft in flight has manoeuvred in response to an ACAS Resolution Advisory.

(3) *Bird Hazards and Strikes*

***(i) A commander shall immediately inform the local air traffic service unit whenever a potential bird hazard is observed.***

***(ii) If he is aware that a bird strike has occurred, a commander shall submit a written bird strike report after landing to the Authority whenever an aircraft for which he/she is responsible suffers a bird strike that results in significant damage to the aircraft or the loss or malfunction of any essential service. If the bird strike is discovered when the commander is not available, the operator is responsible for submitting the report.***

(4) *Dangerous Goods Incidents and Accidents*. An operator shall report dangerous goods incidents and accidents to the Authority and the appropriate Authority in the State where the accident or incident occurred, as provided for in Appendix 1 to OPS 1.1225. The first report shall be despatched within 72 hours of the event unless exceptional circumstances prevent this and include the details that are known at that time. If necessary, a subsequent report must be made as soon as possible giving whatever additional information has been established. (See also OPS 1.1225)]

(5) *Unlawful Interference.* ***Following an act of unlawful interference on board an aircraft, the commander or, in his absence, the operator shall submit a report as soon as practicable to the local Authority and to the Authority in the State of the operator.*** (See also OPS 1.1245)

(6) *Encountering Potential Hazardous Conditions.* ***A commander shall notify the appropriate air traffic services unit as soon as practicable whenever a potentially hazardous condition such as an irregularity in a ground or navigational facility, a meteorological phenomenon or a volcanic ash cloud is encountered during flight.***

## EU-OPS 1 SUBPARTS not addressed in this Section of Part 2 – Legal, other than as indicated

**EU-OPS 1 Sub Part E – ALL WEATHER OPERATIONS (**See Appendix E after Part 4 of this Specialist Document and Refer to Source Document for details. Also see *The All Weather Operations Guide* in this series of Specialist Documents.

**EU-OPS 1 Sub Part F – PERFORMANCE GENERAL**
Refer to Source Document for details

**EU-OPS 1 Sub Part G – PERFORMANCE CLASS 'A'**
Refer to Source Document for details

**EU-OPS 1 Sub Part H – PERFORMANCE CLASS 'B'**
Refer to Source Document for details

**EU-OPS 1 Sub Part I – PERFORMANCE CLASS 'C'**
Refer to Source Document for details

**EU-OPS 1 Sub Part J – MASS AND BALANCE**
Refer to Source Document for further details

**EU–OPS 1.607 - Terminology**

(a) *Dry Operating Mass*: The total mass of the aeroplane ready for a specific type of operation excluding all usable fuel and traffic load. This mass includes items such as:

(1) Crew and crew baggage;
(2) Catering and removable passenger service equipment; and
(3) Potable water and lavatory chemicals.

(b) *Maximum Zero Fuel Mass:* The maximum permissible mass of an aeroplane with no usable fuel. The mass of the fuel contained in particular tanks must be included in the zero fuel mass when it is explicitly mentioned in the Aeroplane Flight Manual limitations.

(c) *Maximum Structural Landing Mass:* The maximum permissible total aeroplane mass upon landing under normal circumstances.

(d) *Maximum Structural Take-off Mass:* The maximum permissible total aeroplane mass at the start of the take-off run.

(e) *Passenger classification.*

(1) Adults, male and female, are defined as persons of an age of 12 years and above.
(2) Children are defined as persons of an age of two years and above but who are less than 12 years of age.
(3) Infants are defined as persons who are less than 2 years of age

(f) *Traffic Load:* The total mass of passengers, baggage and cargo, including any non-revenue load.

**EU–OPS 1.610 - Loading, mass and balance**

An operator shall specify, in the Operations Manual, the principles and methods involved in the loading and in the mass and balance system that meet the requirements of OPS 1.605. This system must cover all types of intended operations.

**EU–OPS 1.615 - Mass values for crew**

(a) An operator shall use the following mass values to determine the dry operating mass:
(1) Actual masses including any crew baggage; or
(2) Standard masses, including hand baggage, of 85 kg for flight crew members and 75 kg for cabin crew members; or
(3) Other standard masses acceptable to the Authority.

(b) An operator must correct the dry operating mass to account for any additional baggage. The position of this additional baggage must be accounted for when establishing the centre of gravity of the aeroplane.

**EU–OPS 1.620 - Mass values for passengers and baggage**

(a) An operator shall compute the mass of passengers and checked baggage using either the actual weighed mass of each person and the actual weighed mass of baggage, or the standard mass values specified in Tables 1 to 3 below, except where the number of passenger seats available is less than 10. In such cases passenger mass may be established by use of a verbal statement by or on behalf of each passenger and adding to it a predetermined constant to account for hand baggage and clothing (See AMC OPS 1.620(a)). The procedure specifying when to select actual or standard masses and the procedure to be followed when using verbal statements must be included in the Operations Manual.

(b) If determining the actual mass by weighing, an operator must ensure that passengers' personal belongings and hand baggage are included. Such weighing must be conducted immediately prior to boarding and at an adjacent location.

(c) If determining the mass of passengers using standard mass values, the standard mass values in Tables 1 and 2 below must be used. The standard masses include hand baggage and the mass of any infant below 2 years of age carried by an adult on one passenger seat. Infants occupying separate passenger seats must be considered as children for the purpose of this sub-paragraph.

(d) *Mass values for passengers – 20 passenger seats or more*

(1) Where the total number of passenger seats available on an aeroplane is 20 or more, the standard masses of male and female in Table 1 are applicable. As an alternative, in cases where the total number of passenger seats available is 30 or more, the 'All Adult' mass values in Table 1 are applicable.

(2) For the purpose of Table 1, holiday charter means a charter flight solely intended as an element of a holiday travel package. The holiday charter mass values apply provided that not more than 5% of passenger seats installed in the aeroplane are used for the non-revenue carriage of certain categories of passengers (See IEM OPS 1.620(d)(2))

**Table 1**

| **Passenger seats** | **20 & more** | | **30 & more** |
|---|---|---|---|
| | **Male** | **Female** | **All adult** |
| All flights except holiday charters | 88 kg | 70 kg | 84 kg |
| Holiday charters | 83 kg | 69 kg | 76 kg |
| Children | 35 kg | 35 kg | 35 kg |

(e) *Mass values for passengers – 19 passenger seats or less.*

(1) Where the total number of passenger seats available on an aeroplane is 19 or less, the standard masses in Table 2 are applicable.

(2) On flights where no hand baggage is carried in the cabin or where hand baggage is accounted for separately, 6 kg may be deducted from the above male and female masses. Articles such as an overcoat, an umbrella, a small handbag or purse, reading material or a small camera are not considered as hand baggage for the purpose of this sub-paragraph.

**Table 2 - (1 to 19 passenger seats)**

| **Passenger seats** | **1 – 5** | **6 – 9** | **10 – 19** |
|---|---|---|---|
| Male | 104 kg | 96 kg | 92 kg |
| Female | 86 kg | 78 kg | 74 kg |
| Children | 35 kg | 35 kg | 35 kg |

(f) *Mass values for baggage*

(1) Where the total number of passenger seats available on the aeroplane is 20 or more the standard mass values given in Table 3 are applicable for each piece of checked baggage. For aeroplanes with 19 passenger seats or less, the actual mass of checked baggage, determined by weighing, must be used.

(2) For the purpose of Table 3:

(i) Domestic flight means a flight with origin and destination within the borders of one State

(ii) Flights within the European region means flights, other than Domestic flights, whose origin and destination are within the area specified in Appendix 1 to EU–OPS 1.620(f); and

(iii) Intercontinental flight, other than flights within the European region, means a flight with origin and destination in different continents

**Table 3 – 20 or more passenger seats**

| Type of flight | Baggage standard mass |
|---|---|
| Domestic | 11 kg |
| Within the European region | 13 kg |
| Intercontinental | 15 kg |
| All other | 13 kg |

(g) If an operator wishes to use standard mass values other than those contained in Tables 1 to 3 above, he must advise the Authority of his reasons and gain its approval in advance. He must also submit for approval a detailed weighing survey plan and apply the statistical analysis method given in Appendix 1 to EU–OPS 1.620(g). After verification and approval by the Authority of the results of the weighing survey, the revised standard mass values are only applicable to that operator; and …

The revised standard mass values can only be used in circumstances consistent with those under which the survey was conducted. Where revised standard masses exceed those in Tables 1–3, then such higher values must be used. (See IEM OPS 1.620(g)).

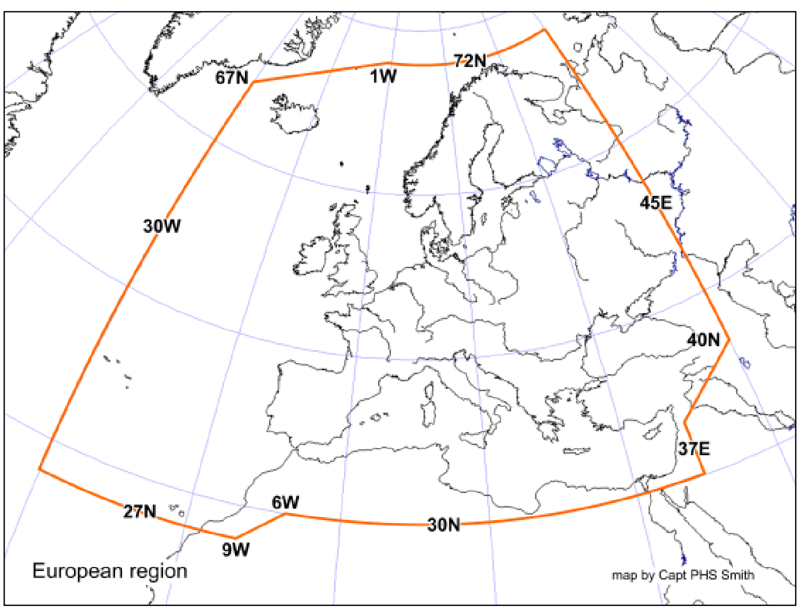
(h) On any flight identified as carrying a significant number of passengers whose masses, including hand baggage, are expected to exceed the standard passenger mass, an operator must determine the actual mass of such passengers by weighing or by adding an adequate mass increment. (See IEM OPS 1.620(h) & (i)).

(i) If standard mass values for checked baggage are used and a significant number of passengers check in baggage that is expected to exceed the standard baggage mass, an operator must determine the actual mass of such baggage by weighing or by adding an adequate mass increment. (See IEM OPS 1.620(h) & (i)).

(j) ***An operator shall ensure that a commander is advised when a non-standard method has been used for determining the mass of the load and that this method is stated in the mass and balance documentation.***

**Appendix 1 to EU–OPS 1.620(f) - Definition of the area for flights within the European region**

For the purposes of EU–OPS 1.620(f), flights within the European region, other than domestic flights, are flights conducted within the area bounded by Rhumb lines between the following points:




| |
|---|
| N7200 E04500 |
| N4000 E04500 |
| N3500 E03700 |
| N3000 E03700 |
| N3000 W00600 |
| N2700 W00900 |
| N2700 W03000 |
| N6700 W03000 |
| N7200 W01000 |
| N7200 E04500 |

**EU–OPS 1.625 - Mass and balance documentation**
(See Appendix 1 to EU–OPS 1.625)

(a) An operator shall establish mass and balance documentation prior to each flight specifying the load and its distribution. ***The mass and balance documentation must enable the commander to determine that the load and its distribution is such that the mass and balance limits of the aeroplane are not exceeded.*** The person preparing the mass and balance documentation must be named on the document. The person supervising the loading of the aeroplane must confirm by signature that the load and its distribution are in accordance with the mass and balance documentation. ***This document must be acceptable to the commander, his acceptance being indicated by countersignature or equivalent.*** (See also EU–OPS 1.1055(a)(12))

(b) An operator must specify procedures for Last Minute Changes to the load.

(c) Subject to the approval of the Authority, an operator may use an alternative to the procedures required by paragraphs (a) and (b) above.

A**ppendix 1 to EU–OPS 1.625 Mass and Balance Documentation**
See IEM to Appendix 1 to EU–OPS 1.625

(a) Mass and balance documentation
  (1) Contents
    (i) The mass and balance documentation must contain the following information:
      (A) The aeroplane registration and type;
      (B) The flight identification number and date;
      (C) The identity of the Commander;
      (D) The identity of the person who prepared the document;
      (E) The dry operating mass and the corresponding CG of the aeroplane;
      (F) The mass of the fuel at take-off and the mass of trip fuel;
      (G) The mass of consumables other than fuel;
      (H) The components of the load including passengers, baggage, freight and ballast;
      (I) The Take-off Mass, Landing Mass and Zero Fuel Mass;
      (J) The load distribution;
      (K) The applicable aeroplane CG positions; and
      (L) The limiting mass and CG values.
    (ii) Subject to the approval of the Authority, an operator may omit some of this Data from the mass and balance documentation.

  (2) *Last Minute Change (LMC).* ***If any last minute change occurs after the completion of the mass and balance documentation, this must be brought to the attention of the commander and the last minute change must be entered on the mass and balance documentation. The maximum allowed change in the number of passengers or hold load acceptable as a last minute change must be specified in the Operations Manual. If this number is exceeded, new mass and balance documentation must be prepared.*** **Editors' Note: If the LMC load has a higher priority than pre-loaded masses, then re-distribution can cause significant delays and Commanders need strong guidance as to handling this situation.**

(b) *Computerised systems.* Where mass and balance documentation is generated by a computerised mass and balance system, the operator must verify the integrity of the output data. He must establish a system to check that amendments of his input data are incorporated properly in the system and that the system is operating correctly on a continuous basis by verifying the output data at intervals not exceeding 6 months.

(c) *Onboard mass and balance systems.* An operator must obtain the approval of the Authority if he wishes to use an onboard mass and balance computer system as a primary source for despatch.

(c) *Datalink.* ***When mass and balance documentation is sent to aeroplanes via data-link, a copy of the final mass and balance documentation as accepted by the commander must be available on the ground.***

## EU-OPS 1 SUBPARTS not addressed in this Section of Part 2 – Legal

**EU-OPS 1 Sub Part K – INSTRUMENTS AND EQUIPMENT**
Refer to Source Document for details

**EU-OPS 1 Sub Part L – COMMUNICATION AND NAVIGATION EQUIPMENT**
Refer to Source Document for details

**EU-OPS 1 Sub Part M – AEROPLANE MAINTENANCE**
Refer to Source Document for details

**EU-OPS 1 Sub Part N – FLIGHT CREW**

**EU-OPS 1.940 - Composition of Flight Crew**
(See Appendices 1 & 2 to EU-OPS 1.940)

(a) An operator shall ensure that:

(1) The composition of the flight crew and the number of flight crew members at designated crew stations are both in compliance with, and no less than the minimum specified in, the Aeroplane Flight Manual (AFM);

(2) The flight crew includes additional flight crew members when required by the type of operation, and is not reduced below the number specified in the Operations Manual;

(3) All flight crew members hold an applicable and valid licence acceptable to the Authority and are suitably qualified and competent to conduct the duties assigned to them;

(4) Procedures are established, acceptable to the Authority, to prevent the crewing together of inexperienced flight crew members (See AMC OPS 1.940(a)(4));

(5) ***One pilot amongst the flight crew, qualified as a pilot-in-command in accordance with the requirements governing Flight Crew Licenses, is designated as the commander who may delegate the conduct of the flight to another suitably qualified pilot;*** and

(6) When a dedicated System Panel Operator is required by the AFM, the flight crew includes one crew member who holds a Flight Engineer's licence or is a suitably qualified flight crew member and acceptable to the Authority.

(7) When engaging the services of flight crew members who are self-employed and/or working on a freelance or part-time basis, the requirements of Subpart N are complied with. In this respect, particular attention must be paid to the total number of aircraft types or variants that a flight crew member may fly for the purposes of commercial air transportation, which must not exceed the requirements prescribed in EU-OPS 1.980 and EU-OPS 1.981, including when his services are engaged by another operator.

***For crew members serving the operator as a commander, initial operator's Crew Resource Management (CRM) training shall be completed before commencing unsupervised line flying. However, for crew members serving the operator as a commander after 1 April 2002, initial CRM training shall be completed before commencing unsupervised line flying unless the crew member has previously completed an initial operator's CRM course.***

(b) Minimum flight crew for operations under IFR or at night. For operations under IFR or at night, an operator shall ensure that:

(1) For all turbo-propeller aeroplanes with a maximum approved passenger seating configuration of more than 9 and for all turbojet aeroplanes, the minimum flight crew is 2 pilots; or

(2) Aeroplanes other than those covered by sub-paragraph (b)(1) above are operated by a single pilot provided that the requirements of Appendix 2 to OPS 1.940 are satisfied. If the requirements of Appendix 2 are not satisfied, the minimum flight crew is 2 pilots.

**EU–OPS 1.955 - Nomination as commander**

(a) ***An operator shall ensure that for upgrade to commander from co-pilot and for those joining as commanders:***

(1) A minimum level of experience, acceptable to the Authority, is specified in the Operations Manual; &

(2) For multi-crew operations, the pilot completes an appropriate command course.

(b) The command course required by subparagraph (a)(2) above must be specified in the Operations Manual and include at least the following:

(1) Training in an STD (including Line Orientated Flying Training) and/or flying training;

(2) An operator proficiency check operating as commander;

(3) Commander's responsibilities;

(4) Line training in command under supervision. A minimum of 10 sectors is required for pilots already qualified on the aeroplane type;

(5) Completion of a commander's line check as prescribed in OPS 1.965(c) and route and aerodrome competence qualification as prescribed in OPS 1.975; and

(6) Elements of Crew Resource Management.

**EU-OPS 1.960 - Commanders holding a Commercial Pilot Licence**

(a) An operator shall ensure that:

(1) ***A Commercial Pilot Licence (CPL) holder does not operate as a commander of an aeroplane certificated in the Aeroplane Flight Manual for single pilot operations unless:***

(i) When conducting passenger carrying operations under Visual Flight Rules (VFR) outside a radius of 50 nm from an aerodrome of departure, the pilot has a minimum of 500 hours total flight time on aeroplanes or holds a valid Instrument Rating; or

(ii) When operating on a multiengine type under Instrument Flight Rules (IFR), the pilot has a minimum of 700 hours total flight time on aeroplanes which includes 400 hours as pilot-in-command (in accordance with [the requirements governing Flight Crew Licenses]) of which 100 hours have been under IFR including 40 hours multi-engine operation. The 400 hours as pilot-in-command may be substituted by hours operating as co-pilot on the basis of two hours co-pilot is equivalent to one hour as pilot-in-command provided those hours were gained within an established multi-pilot crew system prescribed in the Operations Manual;

(2) In addition to sub-paragraph (a)(1)(ii) above, when operating under IFR as a single pilot, the requirements prescribed in Appendix 2 to EU-OPS 1.940 are satisfied; and

(3) In multi-pilot crew operations, in addition to sub-paragraph (a)(1) above, and prior to the pilot operating as commander, the command course prescribed in EU-OPS 1.955(a)(2) is completed

**EU-OPS 1.965 - Recurrent training and checking**
(See source document OPS 1 for further details & see Appendices 1 & 2 to OPS 1.965)

(a) General. An operator shall ensure that: each flight crew member undergoes recurrent training and checking and that all such training and checking is relevant to the type or variant of aeroplane on which the flight crew member operates;

(b) *Operator Proficiency Check.* The period of validity of an operator proficiency check shall be 6 calendar months in addition to the remainder of the month of issue.

(c) *Line Check.* The period of validity of a line check shall be 12 calendar months, in addition to the remainder of the month of issue
.
(d) *Emergency and Safety Equipment training and checking*. The period of validity of an emergency and safety equipment check shall be 12 calendar months in addition to the remainder of the month of issue.

(e) *CRM.* All major topics of CRM training shall be covered over a period not exceeding 3 years;

(f) *Ground and Refresher training* at least every 12 calendar months.

(g) *Aeroplane/STD training* at least every 12 calendar months.

**EU–OPS 1.968 - Pilot qualification to operate in either pilot's seat (See Appendix 1 to OPS 1.968)**

(a) An operator shall ensure that:

(1) A pilot who may be assigned to operate in either pilot's seat completes appropriate training and checking

**EU-OPS 1.970 - Recent experience**

(a) An operator shall ensure that:

(1) A pilot is not assigned to operate an aeroplane as part of the minimum certificated crew, either as pilot flying or pilot non-flying, unless he has carried out three take-offs and three landings in the previous 90 days as pilot flying in an aeroplane, or in a flight simulator, of the same type/class.

(2) A pilot who does not hold a valid instrument rating is not assigned to operate an aeroplane at night as commander unless he has carried out at least one landing at night in the preceding 90 days as pilot flying in an aeroplane, or in a flight simulator, of the same type/class.

(b) The 90 day period prescribed in subparagraphs (a)(1) and (2) above may be extended up to a maximum of 120 days by line flying under the supervision of a Type Rating Instructor or Examiner. For periods beyond 120 days, the recency requirement is satisfied by a training flight or use of a Flight Simulator of the aeroplane type to be used.

**EU-OPS 1.975 - Route and Aerodrome Competence qualification (See AMC OPS 1.975)**

(a) An operator shall ensure that, prior to being assigned as commander or as pilot to whom the conduct of the flight may be delegated by the commander, the pilot has obtained adequate knowledge of the route to be flown and of the aerodromes (including alternates), facilities and procedures to be used

(b) The period of validity of the route and aerodrome competence qualification shall be 12 calendar months in addition to the remainder of:

(1) The month of qualification; or

(2) The month of the latest operation on the route or to the aerodrome.

(c) Route and aerodrome competence qualification shall be revalidated by operating on the route or to the aerodrome within the period of validity prescribed in sub-paragraph (b) above.

(d) If revalidated within the final 3 calendar months of validity of previous route and aerodrome competence qualification, the period of validity shall extend from the date of revalidation until 12 calendar months from the expiry date of that previous route and aerodrome competence qualification

**Editor's Note: The 28 day recency for landings required for UK AOC holders before EASA became the Regulator for all EC operators, seems to be left to the discretion of operators**

## EU-OPS 1 SUB-PARTS not addressed in this Section of Part 2 – Legal

**EU-OPS 1 Sub Part O – CABIN CREW**
Refer to Source Document for details

**EU-OPS 1 Sub Part P – MANUALS, LOGS AND RECORDS**
Refer to Source Document for details

**EU-OPS 1 Sub Part Q – FLIGHT AND DUTY TIME LIMITATIONS AND REST – REQUIREMENTS**

*RESERVED*

**EU-OPS 1 Sub Part R – TRANSPORT OF DANGEROUS GOODS BY AIR**
Refer to Source Document for further details

**EU–OPS 1.1145 - General**

An operator must comply with the applicable provisions contained in the Technical Instructions, irrespective of whether:

(a) The flight is wholly or partly within or wholly outside the territory of a state; or

(b) An approval to carry dangerous goods in accordance with EU-OPS 1.1155 is held.

**EU–OPS 1.1155 - Approval to Transport Dangerous Goods**

(a) An operator shall not transport dangerous goods unless approved to do so by the Authority

**EU–OPS 1.1215 - Provision of Information**

(c) ***Information to the Commander.*** An operator shall ensure that:

**(1)** ***Written information is provided to the commander about the dangerous goods to be carried on an aeroplane, as specified in the Technical Instructions;***

**(2)** ***Information for use in responding to in flight emergencies is provided, as specified in the Technical Instructions;***

**(3)** ***A legible copy of the written information to the commander is retained on the ground at a readily accessible location until after the flight to which the written information refers. This copy, or the information contained in it, must be readily accessible to the aerodromes of last departure and next scheduled arrival point, until after the flight to which the information refers;***

**(4)** ***Where dangerous goods are carried on a flight which takes place wholly or partially outside the territory of a State, the English language is used for the written information to the commander in addition to any other language requirements.]***

*(See Table 1 of Appendix 1 to EU-OPS 1.1065 for the document storage period).*

[d] Information in the Event of an Aeroplane Incident or Accident.

(1) The operator of an aeroplane which is involved in an aeroplane incident shall, on request, provide any information as required by the Technical Instructions.]

(2) The operator of an aeroplane which is involved in an aeroplane accident or serious incident shall without delay, provide any information as required by the Technical Instructions.

(3) The operator of an aeroplane shall include procedures in appropriate manuals and accident contingency plans to enable this information to be provided.

(e) Information in the Event of an In-flight Emergency (See ACJ OPS 1.1215(e)).

(1) If an in-flight emergency occurs the commander shall, as soon as the situation permits, inform the appropriate air traffic services unit of any dangerous goods carried as cargo on board the aeroplane as specified in the Technical Instructions.

**EU–OPS 1.1225 - Dangerous Goods Incident and Accident Reports** (See ACJ OPS (AMC) 1.1225)

(a) An operator shall report dangerous goods incidents and accidents to the Authority and the appropriate Authority in the State where the accident or incident occurred, as provided for in Appendix 1 to OPS 1.1225. The first report shall be despatched within 72 hours of the event unless exceptional circumstances prevent this and include the details that are known at that time. If necessary, a subsequent report must be made as soon as possible giving whatever additional information has been established.

(b) An operator shall also report to the Authority and the appropriate Authority in the State where the event occurred, the finding of undeclared or misdeclared dangerous goods discovered in cargo or passengers' baggage as provided for in Appendix 1 to OPS 1.1225. The first report must be despatched within 72 hours of the discovery unless exceptional circumstances prevent this and include the details that are known at that time. If necessary, a subsequent report must be made as soon as possible giving whatever additional information has been established.

**EU-OPS 1 Sub Part S – SECURITY**

**EU-OPS 1.1245 - Reporting acts of unlawful interference**

***Following an act of unlawful interference on board an aeroplane the commander or, in his absence the operator, shall submit, without delay, a report of such an act to the designated local authority and the Authority in the State of the operator.***

**EU-OPS 1.1255 - Flight crew compartment security**

(a) In all aeroplanes which are equipped with a flight crew compartment door, this door shall be capable of being locked, and means or procedures acceptable to the Authority shall be provided or established by which the cabin crew can notify the flight crew in the event of suspicious activity or security breaches in the cabin.

(b) All passenger-carrying aeroplanes of a maximum certificated take-off mass in excess of 45,500 kg or with a Maximum Approved Passenger Seating Configuration greater than 60 shall be equipped with an approved flight crew compartment door that is capable of being locked and unlocked from each pilot's station and designed to meet the applicable retroactive airworthiness operational requirements. The design of this door shall not hinder emergency operations, as required in applicable retroactive airworthiness operational requirements.

(c) In all aeroplanes which are equipped with a flight crew compartment door in accordance with sub-paragraph (b):

(1) ***This door shall be closed prior to engine start for take-off and will be locked when required by security procedure or the Commander, until engine shut down after landing, except when deemed necessary for authorised persons to access or egress in compliance with National Aviation Security Programme;***

(2) Means shall be provided for monitoring from either pilot's station the area outside the flight crew compartment to the extent necessary to identify persons requesting entry to the flight crew compartment and to detect suspicious behaviour or potential threat.

**SECTION 6 - THE TECHNICAL RESPONSIBILITIES OF AN AIRCRAFT CAPTAIN**
by Captain Tim Sindall FRAeS

## 6.1 INTRODUCTION

Within this Section and purely for the sake of consistency, the term 'captain' should be taken to mean what is elsewhere described as 'pilot-in-command' (International Civil Aviation Organisation – ICAO) or 'commander' (UK Air Navigation Order and EU/EU Operations). Although all three terms are similar yet contain subtle differences, it will be easier for the reader if only one of these is used here.

The technical responsibilities of a captain will be found in whatever legislation is prescribed by the State in which the aircraft is registered and which has licensed the pilot and, if applicable, the air transport undertaking for whom he/she works. In addition, the State may publish advisory or guidance material, which may widen the scope of technical responsibilities. Both State regulations and guidance material will be based upon ICAO Standards and Recommended Practices (SARPs) but will probably recognise and reflect other 'best practice' guides developed by the State and made on the basis of recommendations stemming from accident investigations, or initiated by the aircraft, avionic and engine manufacturing industries.

For pilots of aircraft involved in commercial air transport operations, the technical responsibilities must be specified in the company's operations manual (OM), which operators are required to produce in order that they may be issued with and continue to hold an Air Operator Certificate. As the technical responsibilities for a commercial air transport pilot are the highest/most demanding for any captain, the remainder of this document is based upon this standard.

## 6.2 THE DUTIES OF A CAPTAIN – IN GENERAL TERMS

The captain can expect to be responsible for the safety of all crew members, passengers and cargo on board an aircraft as soon as he/she arrives on board and until he/she leaves the aircraft at the end of the flight.

However, with an eye to the technical responsibilities of a captain, he/she can expect to be responsible for the operation and safety of the aircraft from the moment the aircraft is first ready to move, for the purpose of taxiing prior to take-off, until the moment it finally comes to rest at the end of the flight and the engine(s) used as primary propulsion units are shut down. Where taxiing under power without the intention of taking off immediately thereafter, or after disembarking passengers at the end of a flight occur, as can often be the case with helicopters, the OM should make clear that the captain retains responsibility throughout for the continued operation and safety of the aircraft.

In summary, the captain is responsible for the safety of all on board the aircraft throughout the time he/she is on board, but responsible for the operation and safety of the aircraft only when he/she is able to exercise control over where it is going. Thus, it may be inferred that a captain should not be held to account for any damage to the static aircraft that takes place whilst refuelling, catering or de-icing or even to the moving aircraft when it is being positioned by a tug.

### 6.2.1 Pre-flight walk-round

Company procedures may allow the captain to delegate the pre-flight walk round inspection to any other qualified pilot or flight engineer who forms part of the operating crew. Many captains may nevertheless wish to perform this check themselves, given that they are soon to be taking responsibility for the technical state of the aircraft.

Dangers inherent when performing this check include being knocked over by a moving vehicle, tripping over a chock, tow-bar or stray piece of luggage, or making physical contact with some part of the airframe, engine or propeller. Many companies and aerodromes insist that high visibility tabards are worn to help prevent the first-named problem, but the captain does need constantly to look where he/she is walking when outside the aircraft. It is essential that the 'external inspector' is properly protected against the elements, including foot-wear. The ramp area will be littered and contaminated with all manner of debris and fluid run-off, despite the best efforts of aerodrome operators to maintain required levels of cleanliness.

Most readers will have performed many such checks, but it is perhaps apposite to mention that having a torch to hand for use when peering into dark recesses does help improve the quality of the inspection, as does a reminder to concentrate on the item being inspected – to both look and see what is being examined so that anything untoward is identified. It is essential that the type-specific training for the flight crew includes a clear demonstration of what they should expect to see, too.

When checking for ice and snow deposits on the aircraft, using a torch or wing inspection lights at night, a check of the upper surface of the wings from inside the cabin is highly recommended, to ensure that de-icing has cleared the top surfaces from snow and ice deposits. Passengers may wonder and feel uncomfortable about what is going on, so a few words in explanation would dispel concerns. The point to make is that in the interests of safety, a check is being made to confirm that de-icing fluids applied to the aircraft have effectively removed all snow and ice deposits from the upper wing surface that must be clear of such contamination. A clean aircraft is a vital essential for flight and this check is part of the procedure to ensure a safe take-off.

## 6.3 THE ROLE OF THE TECHNICAL LOG

The technical log (tech log) is a document that contains information that is sufficient to enable a ground engineer or crew member to ascertain at any time the airworthiness state of the aircraft. Whenever an aircraft is positioned so as to be available for a flight, the tech log should be on the aircraft, commonly on the flight deck in an appropriate stowage. Ground engineers sometimes remove the tech log for their own reasons, but it is prudent for the captain to have access to it early on in the pre-flight checks. There may be activities going on associated with defect rectification on aircraft systems that the crew will need to check and the safety state of these systems can be compromised while the maintenance is going on. As a rule, never changeover electrical power, pressurise a hydraulic or pneumatic system or activate any controls, unless formal clearance has been given to do so. Thus when the ground engineer presents the tech log to the captain for the latter to accept, he/she should check the relevant items with great care, making time, if necessary, to do this task thoroughly. This part of pre-flight checks is ‘time-management critical’ and the captain must not allow him/herself to be rushed. It is vitally important to remain focused and avoid ‘seeing what you expect to see’.

The identification of the aircraft should be prominently displayed on every page of the log, and all pages should be numbered in sequence. Therefore, the captain can, by inspection, assure him/herself that the recent history of flights, defects, rectification, routine maintenance and replenishment of systems (hydraulics, engine oil, fuel, etc) is complete. All defects entered into the tech log should have been rectified and any that haven’t, but which might be acceptable for the planned flight (by reference to supporting documents such as the minimum equipment list, of which more later), must have suitable entries.

*Editor’s note:* Be aware that there are such things as ‘Conditional Dispatch’ entries in the ‘Tech log’. An example of this is where the aircraft has to be de-iced at the very last opportunity before take-off and the de-icing is carried out at some remote location near the runway. The ‘Tech Log’ will contain an entry that the de-icing has been carried out, with the specification of the fluid mix to be used, e.g. Hot 75/25 Type II. The captain will sign for this before closing doors and starting engines or being towed, but the time that de-icing was actually carried-out is only entered on the tech log page retained on the flight deck later; after agreeing the time with the de-icing service provider and ensuring that the ground-held copy of the tech log page is similarly annotated. This ensures that any ‘Hold-Over Time is accurately calculated.

The tech log may contain elsewhere than on the pages relating to the previous flight(s) a separate list of deferred defects and out-of-phase inspections that the captain will need to read, since these may impose limitations that could affect how the next flight is conducted. They may also contain time or ‘number of sectors’ constraints that need to be borne in mind lest they require operations to stop or else continue without passengers or cargo on board before the aircraft returns to a place where defect rectification can take place. Very occasionally, the tech log may stipulate a maximum number of Landings permitted and this needs to be ‘remembered’ if there were to be an en-route diversion for any reason.

Where a hard-copy tech log is used, the captain should check that there are a sufficient number of pages remaining in the document to enable the record of flights to be continued before the aircraft returns to its base, and he/she should request that new book of pages be placed on board if there is any doubt that the existing log may ‘run out’. If a new ‘book’ is used, then the captain must make reference in both the old and new versions to the page sequence numbers, so that the flight history remains intact.

Acceptance of the aircraft is normally by captain’s signature. The OM will contain details of what must be checked and how acceptance is to be recorded. In hard-copy versions, one or more pages of the log will then be removed and left on the ground as a permanent record as to the serviceability state of the aircraft at the point of departure, lest disaster occur before the aircraft next lands safely. After flight, the captain must ensure that all relevant details are noted clearly in the spaces provided and, in fulfilment of legal requirements, sign and date in the allotted spaces that he/she has done so.

Where turn-rounds occur without the participation of a ground engineer, the captain will be responsible for making appropriate entries into the tech log before he/she signs it. There will be attendant tasks such as a pre-flight walk round which may or may not follow completion of refuelling, catering, toilet fluid replenishment, unloading/loading, etc. If there should be any doubt about the ability of ground staff to load baggage/containers in the correct holds or to close up external fuelling panels, then the captain should ensure that one member of the operating crew makes a specific check to ensure that the job has been done properly. Authority to make certain entries in the tech log by crew members who are not licensed engineers will be provided by the approved maintenance organisation, after appropriate training has been given and subsequently accepted by the company (the operator).

In some airlines, aircraft maintenance responsibility can be divided between one department that attends to its basic airworthiness, and another that is responsible for cabin defect rectification, for which there will be a cabin-specific tech log. This may be handled by the senior cabin crew member, who will do their own checks as to cabin systems serviceability. However, if any such defect might have a bearing on the aircraft safety systems status, e.g. the PA or Interphone systems, then this must be brought to the flight crew’s attention, so that it can be ‘transferred’ to the main aircraft tech log. The prudent captain will ensure that the cabin crew keeps him/her appraised, should such a problem be present.

## 6.4 USE OF MINIMUM EQUIPMENT LISTS (MELS)

### 6.4.1 Master and Minimum Equipment Lists

The type-specific Master Minimum Equipment List (MMEL), developed by the aircraft manufacturer for all but the smallest air transport aircraft, which may have a generic MMEL, addresses all foreseen airworthiness defects with which the aircraft may be dispatched safely subject, in most cases, to limitations. Responsibility for developing the MMEL rests with the aircraft manufacturer simply because he is best placed to understand the inter-relationship between the many different systems that exist in that type, and so determine how failure of one item may affect others in the same and/or different systems. The MMEL does not address obvious defects such as cracked, or broken, or missing components that can obviously not be accepted for dispatch.

The minimum equipment list (MEL), which is what the captain will find on board the aircraft, comprises the MMEL to which have been added constraints that will affect the type of operations that can be undertaken and any maintenance actions that must be performed. Examples of the former are: that flights must not be made at night, or that performance calculations must include additional requirements, or that flights that will take the aircraft beyond a specified flying time from an adequate aerodrome must not be commenced. Examples of maintenance action are: specific verification that one of two items is operative before flight (where the other is known to be unserviceable), or that placards and sometimes physical locks (i.e. thrust reversers) must be applied to prevent inadvertent selection of a control.

Acceptance for dispatch of an aircraft that has an unserviceability or defect listed in the MEL is entirely at the discretion of the captain since he or she is most likely the only person who will have total understanding of what can be expected to occur on the flight or series of flights that lie ahead (e.g., day/night, VMC/IMC, in-flight icing, avionic aids required for RNAV/RNP, performance-limited runways, etc). Also, of course, it is the captain alone who will be responsible for the safe operation of the aircraft once it starts moving.

#### 6.4.2 Operations with Multiple Unserviceabilities

The decision as to whether or not to dispatch with multiple unserviceabilities, which individually would be allowed by the MEL, will ultimately rest with the Aircraft Commander, taking into consideration advice from the operator's specialists, where available.

### 6.5 IN-FLIGHT TECHNICAL RESPONSIBILITIES

Once the aircraft has departed, the provisions of the MEL do not normally apply ‘as for dispatch’. If a technical problem arises, the captain should use the appropriate checklist to guide the crew’s actions to isolate the fault and change to an alternative system, if available, and assess whether or not the flight can continue without restriction. In some instances, the contents of the MEL can provide a useful clue as to what the captain might want to think about in terms of limitations on that or any planned following sectors.

Most modern high performance aircraft have considerable redundancy built in so as to enable the flight to continue to the planned destination. However, sometimes a defect occurs such that the likelihood at destination would render the aircraft incapable of continued operation, due to the technical shortcomings at that destination. Consideration might be given towards diverting to an alternative destination, initiating contact with the company for guidance if necessary. Thus the captain should not ignore the MEL during the latter stages of flight, if such a ‘limiting’ defect has arisen.

The captain should ensure at certain intervals that all systems are functioning correctly, by looking at all the indicators. For many aircraft, this will include paging through the various displays (fuel, hydraulic, electrics, etc). Fuel contents remaining should be regularly noted against a separate plan of predicted fuel burn, i.e., a cross check between how much fuel there should be on board against a pre-flight calculation as to how much there ought to be at that point. If a difference becomes apparent, then the captain should ascertain the reason and, if necessary, take action accordingly. On the technical front, if a leak has arisen, then checklist action would appear necessary followed by an appraisal as to what operational changes might have to follow, such as diversion to a suitable aerodrome. If no technical malfunction has occurred, then possible corrective action may require a change of flight plan (e.g. a shorter track or a change of flight level to be requested from ATC).

Good and effective crew resource source management (CRM) is essential when in-flight problems arise, both technical (e.g. systems failures) and operational (e.g. fuel shortages). This is when any input – advice and observations – from all crew members who can help, and should be sought. Of course, it is the captain who has to make the final decision, but he/she is much better placed if in possession of all the facts. Quite possibly, advice can also be obtained from company operations by radio and data links, and this should be assessed along with what the crew can suggest as to how the flight may or should proceed.

The captain whose aircraft now has a systems failure may ease his or her problems if, well before arriving in the vicinity of the aerodrome where the landing is to be made, he/she contacts the controllers at that aerodrome – using company operations if available – to inform them of any special requirements. For example, an A300-600 continuing flight with one major hydraulic system unserviceable may need a long final approach in which to lower the landing gear manually, followed by an early landing clearance so that the likelihood of a go-around becomes extremely remote. Notification that braking, once on the runway, will be degraded resulting in a longer landing distance requirement followed by slow vacation of the runway due to loss of nose-wheel steering, will assist the Tower to adjust the normal space between the A300 and the following aircraft, and the provision of a tug located at the planned exit point will help minimise the length of time that the taxiway will be blocked.

Landing after a hydraulic loss within the landing gear systems will almost certainly cause significant amounts of fluid to remain around the components. Braking action will cause fumes to become generated, often visible to the cabin occupants. The Emergency Services will be on hand and able to give the captain advice about this, so their interpretation must be carefully considered. Unnecessary evacuation of the aircraft should be avoided, if at all possible, particularly on a large aircraft such as a B747 when a number of serious injures can be expected, including possible fatalities.

Of course, a discreet briefing of the cabin crew prior to arrival will be necessary and, at some point, the captain will also need to say something to the passengers, but whether this is done before or after landing will depend upon circumstances. Passengers tend to be concerned when they see Emergency Service vehicles closing on the aircraft after it has landed, and their probable apprehension should not be forgotten.

The point to be borne in mind in all circumstances following an in-flight technical malfunction of the aircraft and its systems is, when you are able to do so, plan ahead for the landing or the next associated failure, whichever comes next!

## SECTION 7 - FUEL PLANNING AND MANAGEMENT FOR CAPTAINS

by Captain Tim Sindall FRAeS

**Preamble to Section 7**

***There is much that could be said on the topic of fuel planning and management. However, the following Section remains focused on how new captains should comply with EU-OPS 1 - the basis of the dissertation - without expanding beyond that. When converting to type, pilots will almost certainly be taught the fuel management procedures applicable to their new aircraft type, to satisfy Company Orders and Legislation.***

### 7.1 INTRODUCTION

Within this appendix, and purely for the sake of consistency, the term 'captain' should be taken to mean what is elsewhere described as 'pilot-in-command' (International Civil Aviation Organisation – ICAO) or 'commander' (UK Air Navigation Order and EU/EU Operations). Although all three terms are similar yet contain subtle differences, it will be easier for the reader if only one of these is used here.

Not until the new captain plans and operates his or her first sector without training staff on board, will responsibility for deciding upon the appropriate fuel quantity required for the flight become apparent. This is an accountability that cannot be truly appreciated for as long as someone else such as a training captain, who has legal responsibility for commanding the aircraft, makes that decision - and signs accordingly!

The purpose of this appendix is to help identify what a captain is expected to consider when deciding how much fuel should be in the tanks when the engines are started and how to manage it thereafter, with the expectation that when the aircraft arrives at its destination, there will still be adequate reserves that can be used in the event that the landing is delayed.

For the sake of clarity, the fuel planning and management model used is that contained in EU-OPS 1 (developed from EU-OPS 1 at Amendment 13). Although the EU/EU-OPS 1 standard, which is applicable to Commercial Air Transport (CAT), exceeds requirements for general aviation (GA). It cannot be read across directly by pilots of helicopters (for whom guidance can be obtained by reading EU-OPS 3 and its successor documents). It nevertheless embodies principles of fuel planning and management that should be of use to captains of both CAT and GA aircraft.

### 7.2 FUEL PLANNING - GENERAL

ICAO Annex 6 (Operation of Aircraft) Parts I and III (International Commercial Air Transport – Aeroplanes/Helicopters) contains the fundamentals of fuel planning, thus:

*A flight shall not be commenced unless, taking into account both the meteorological conditions and any delays that are expected in flight, the aeroplane/helicopter carries <u>sufficient fuel and oil to ensure that it can safely complete the flight</u>. In addition, <u>a reserve shall be carried to provide for contingencies</u>.*

All ICAO Contracting States are expected to reflect these two requirements into their national legislation (e.g. UK Air Navigation Order/EU/EU/EASA OPS) and 'flesh them out' with detailed guidance as to how they should be interpreted (e.g. to comprise elements such as trip fuel, reserve fuel, etc). Each air operator/air carrier must then specify in their operations manual (OM), for each type of aircraft listed on the air operator certificate (AOC), details of the quantities that must be used in pre-flight fuel planning and in decision-making once the aircraft is in flight (e.g. taxi fuel and the point at which an emergency must be declared).

The most commonly-used format for fuel planning, in effect for deciding before flight what quantity or mass/weight of fuel must be in aircraft tanks before the engines are started, such that the operator's type-specific instructions are complied with, is a series of elements that together comprise:

a. What is required to satisfy all that can be foreseen if the flight proceeds without hindrance,

b. What is required as a reserve to include what might not reasonably be foreseen (such as not receiving optimal flight levels, diversion to a destination alternate, etc).

The basic model that is used by most UK air operators is described.

### 7.3 THE EU-OPS 1 FUEL PLANNING MODEL

The usable fuel contained on board before flight will comprise Taxi Fuel, Trip Fuel, Reserve Fuel and Extra Fuel (if required by the captain). Fuel consumption rates and minimum quantities, such as fuel to be used as Final Reserve Fuel, must be specified in the OM and must be realistic. Pre-flight planning must also take account of the anticipated mass/weight of the aircraft, the expected meteorological conditions and air navigation services providers' procedures and restrictions. (The term 'weight' will be used hereafter to mean both 'mass' and 'weight').

Taking each element in turn:

7.3.1 Taxi Fuel

Taxi Fuel may often be specified in the OM as a 'standard' value applicable to each type of aeroplane listed in the AOC, but there are occasions when a more accurate, realistic value may be required. Where prolonged taxiing or other delays can be anticipated after engine start, use of a 'standard' value may result in the aircraft commencing its take-off with less fuel on board than desired, leading to a deficit when in-flight fuel consumption checks are first carried out. Conversely, use of the 'standard' value where the time between engine start and take-off is expected to be brief may result in the aircraft starting its approach to land at an all-up weight that exceeds its regulated maximum landing weight. This can quite often be a consideration when the aircraft leaves carrying 'round-trip' fuel for an 'out-and-back- flight. Thus, although use of a 'standard' value may be perfectly satisfactory for most occasions, this may not always be the case and so any flexibility to increase or decrease the amount specified in the OM should be employed if permitted and the need arises. Fuel likely to be consumed by the APU should be included in Taxi Fuel.

7.3.2 Trip Fuel

Trip Fuel must always reflect all that can reasonably be foreseen for the flight including:

a. Fuel for take-off and climb from the aerodrome elevation to the initial cruising level/altitude, taking into account the expected departure routing,

b. Fuel from top of climb to top of descent, including any step climb/descent,

c. Fuel from top of descent to the point where the approach is initiated, taking into account the expected arrival procedure, and

d. Fuel for approach and landing at the destination aerodrome.

Just as mentioned above under 'Taxi Fuel', failure to take proper account of the anticipated departure routing (which probably can be predicted) and the most likely arrival routing (which may be more difficult to predict) can result in a short-fall or excess of fuel once the flight has commenced. As an example, when making a flight from Gatwick with its east/west runway to the Spanish mainland (that lies to the south-west), an easterly initial departure can add some four or five minutes of flight time when compared with departures to the west: the amount of fuel consumed in the process can be similar to the amount calculated as Contingency Fuel. So, if no allowance for the easterly extended routing has been made, the aircraft will have little or no Contingency Fuel remaining from the moment it passes abeam Gatwick on its west-bound heading some four or five minutes after getting airborne! Editors' Note: Flight Planners will normally be well aware of departure routings to create the initial plan, but rapidly changing weather conditions can mean a runway change, with attendant departure re-routing consequences.

Trip Fuel planning should include all other influences that can be foreseen. These may include: an expectation that the desired cruising flight level(s) may not be granted by ATC due to regular congestion on popular routes; the presence of weather likely to result in track adjustments (significantly prolonging flight time and/or use of higher fuel consumption combating ice accretion); and holding/delayed commencement of the approach-to-land at the destination aerodrome due to commonly-encountered congestion. When these can be termed 'foreseen' events, proper allowance should be made for them in the Trip Fuel.

7.3.3 Reserve Fuel

Reserve Fuel will include Contingency Fuel and Final Reserve Fuel (often a type-specific standard amount), may include Alternate Fuel (if an alternate is required), and Additional Fuel (if the nature of flight requires it, e.g. for extended/long range operations, isolated aerodrome operations, etc).

a. Contingency Fuel

This is calculated at the pre-flight planning stage to compensate for those factors that cannot reasonably be foreseen such as deviations of an individual aircraft from the expected fuel consumption data; deviations from forecast meteorological conditions; and deviations from planned/expected routings and cruising levels/altitudes.

There are various ways in which Contingency Fuel amounts can be calculated, but the solutions will never be less than a type-specific minimum value. Operations manuals will always specify which calculation methods may be used for each type operated.

For short-range flights, it may be convenient to use 5% (say) of the planned Trip Fuel. However, for long-range sectors an amount calculated by this means may be excessive, especially where adequate aerodromes can easily be reached from the planned route if an en-route refuelling stop becomes necessary. For such flights, a lesser percentage for the whole time of flight may be acceptable to the national authority, or the latter may permit a specific percentage of Trip Fuel for the latter stage of flight from abeam a usable alternate.

Note that the captain must ensure in such circumstances that the en-route alternate aerodrome chosen for this purpose can really be used if needed, and that low visibility, precipitation or works in progress are unlikely to render it unavailable. Other methods that may be accepted by the authority can include an amount of fuel sufficient for 20 minutes of flight as determined by a fuel consumption-monitoring programme, and a statistical method relating to deviations from planned Trip Fuel, as compared with actual consumption on specific routes.

b. Final Reserve Fuel

This is another element in Reserve Fuel, and comprises, for aeroplanes that have reciprocating (piston) engines, fuel to fly for 45 minutes; and for aeroplanes powered by turbo-jet and turbo-propeller engines, fuel required to fly for 30 minutes at 1,500 ft above the aerodrome in standard conditions at the weight the aircraft is expected to be at that point. Purely for the sake of simplicity, air operators may specify a value that reflects the largest amount likely to be required.

c. Alternate Fuel

When this is required, it should be sufficient for a missed approach from the destination aerodrome's MDA/DA to the missed approach altitude, a climb to cruising level/altitude, cruise from top of climb to top of descent, descent to the point where the approach is initiated taking into account the expected arrival procedure, and executing an approach and landing. If two destination alternate aerodromes are required, then Alternate Fuel must be sufficient for reaching the furthermost aerodrome. Again, it is important that the routing should be realistic: drawing a straight line between two aerodromes separated by congested airspace may not properly reflect the track miles to be flown and fuel burn likely to be encountered.

d. Additional Fuel

This becomes a Reserve Fuel element when the nature of flight requires its carriage against the possibility that it might have to be used. For example, loss of pressurisation in an aeroplane carrying passengers might necessitate prolonged flight to an en-route alternate at 10 – 12,000 ft resulting in a significantly increased fuel burn. Another example is where the flight proceeds to an isolated aerodrome where once committed beyond a 'point of safe return' the pilot has no further option but to land at the intended destination. Additional Fuel is then carried to allow the aircraft to loiter in the vicinity of the destination whilst any unexpected adverse weather passes on and conditions improve, permitting an approach to be made.

7.3.4 Extra Fuel

Extra Fuel is fuel added at the pre-flight stage if required by the captain. This should not be a substitute for foreseen elements, all of which should be included in the Trip Fuel, but may be added if the captain considers it desirable. Some operators provide guidance to captains as to how they would wish the latter to assess the need for carrying Extra Fuel. However, if the captain has reasons for wanting this Extra Fuel on board, he/she should not deprive him/herself of it – provided only that the performance of the aircraft and any limitations (such as the maximum regulated take-off weight, or the maximum regulated landing weight at the destination) are not compromised.

***Editors' note:*** Do not allow yourself to be pressurised into <u>not</u> taking any additional fuel which you deem necessary. After all, **<u>you</u>** are in command.

### 7.4 THE USE OF COMPUTERS TO ASSIST WITH PRE-FLIGHT FUEL PLANNING

Computer-generated hard-copy fuel planning logs ('plogs') that depict pre-departure fuel requirements derived from stored data are presented in a form that reflects the operator's specification. Desirably, each element that comprises the pre-departure fuel requirement will be shown separately, as should the fuel expected to be remaining at various stages of the flight and on arrival at the destination aerodrome, (typically this is Alternate Fuel - when required - plus Final Reserve Fuel). For ease of reference in this document, 'Alternate Fuel plus Final Reserve Fuel' is hereafter described as Company Minimum Reserve (CMR) Fuel.

The captain's responsibility at the planning stage is always to satisfy himself/herself that the fuel required has been calculated correctly according to the information available (weather, routing, all-up weight, etc), regardless as to how that calculation was performed. Obviously, the first form of gross-error check that can be done is by relating to personal experience, gained whilst operating the aircraft; but other benchmarks – such as an understanding of hourly fuel burn for the first and succeeding hours of flight – can help to identify significant under- or over-estimates. Other, more sophisticated methods of estimating how the calculated pre-departure fuel amount should appear may be employed, but the main 'teaching point' is that this gross-error check must always be done so as to avoid embarrassment later in the day!

## 7.5 FUEL MANAGEMENT - GENERAL

EU/OPS 1 make clear that an operator must establish a procedure to ensure that in-flight fuel checks and fuel management are carried out.

### 7.5.1 Fuel uplift check

Before starting engines the captain must confirm that the total fuel in tanks, as shown in the aircraft technical log, is the same as was requested and shown on the ‘plog’. This amount should be cross-checked by confirming that the *actual* fuel quantity uplifted from the bowser in litres agrees with what should have been *expected* (i.e. calculated using an appropriate specific gravity).

a. Gross Error Checks

It may be prudent to establish the units of measurement being used by the fuel supplier. Several different terms can be used, and whilst there are 'ready-reckoner' conversion factors, with which both the ground engineers and the refuellers will be familiar, the risk of human error, particularly under time pressure, cannot be ignored. A 'gross error' check made by the captain should establish if the projected uplift required has been delivered. The check will reveal if there has been any miscalculation that will need to be explained. The error, or possibly fraud, could be that fuel delivered to another aircraft may have been included in the current uplift, if the fuel delivery device flow meter was not 'zeroed' prior to delivery! Additionally, one must also consider prolonged running of the APU by ground/maintenance engineers, who, due to distraction or memory lapse, fail to subsequently adjust the Fuel Remaining figure, shown on the inbound sector of the Technical Log. (See paragraph 7.3.1.above for APU fuel handling). Become very alert where unfamiliar units are being used and hence unfamiliar ‘conversion’ factors. Always take your time and avoid any distractions, as the total uplift may be greater than half the total weight of the departing aircraft.

b. Physical Checks

In extreme circumstances, (remember the MEL might apply) it may be necessary to call for or to carry out a physical check of the contents within the tanks, and it is also pertinent to establish that the fuel required is where it should be, as this can have a significant effect on the aircraft trim. If a physical check is called for, then the 'parked attitude' of the aircraft will need to be included. It may be possible to supply this from the on-board FMS raw data page, failing which there may be physical 'sight gauges', typically in or adjacent to one of the landing gear wheel wells. The 'sense' of applying the indicated attitude correction is vitally important, given the swept-wing dihedral of the modern wing planform. In some aircraft, ‘drip sticks’ may be used. In an ideal world, the transition to command should include participation in aircraft refuelling, together with exercises in making uplifted units conversions and physical distribution resolution, together with attitude corrections.

### 7.5.2 In-Flight Fuel Checks

In-flight fuel checks should be carried out at regular intervals, recording usable fuel remaining so as to compare actual consumption with planned consumption. Check that this is sufficient to complete the flight and determine the expected amount of usable fuel that will be remaining on arrival at the destination aerodrome. (In summation, these checks are to ensure that the expected amount remaining will not be less than CMR Fuel).

### 7.5.3 In-Flight Fuel Management

In-flight fuel management describes the processes that the captain may wish to employ when it appears likely that the expected amount remaining will be less than CMR Fuel (and to avoid getting into that situation in the first place). Essentially, it is expected that the captain will decide whether it is acceptable to continue with the current flight plan or to divert to an adequate alternate aerodrome, to be certain of landing with not less than Final Reserve Fuel in either case. Certain in-flight re-planning processes, if these are specified in the OM, may then be employed by the captain, and of course shortening the route, and making changes to the flight level and/or air speed/mach number may help to ensure that CMR Fuel is once again going to be available on arrival at the destination.

### 7.5.4 Declaring an emergency

Almost certainly the captain will be required to declare an emergency if his/her calculations show that the expected fuel on landing at the nearest adequate aerodrome where a safe landing can be performed will be less than Final Reserve Fuel.

## 7.6 IN-FLIGHT FUEL RECORDS

It is sensible to make accurate records as the flight proceeds so that trends in fuel burn can be monitored. Many, but not all ‘PLOGS’ depict against selected waypoints what the fuel remaining should be if CMR Fuel is to remain at the destination. So, if no Contingency Fuel has been consumed, this will still be part of the fuel remaining at the waypoint and show as an excess. If the ‘PLOG’ does not depict predicted in-flight fuel remaining as described (i.e. CMR Fuel adjacent to the destination waypoint), then the crew will need to perform calculations to ensure that meaningful comparisons of predicted against actual fuel amounts remaining can be made at selected waypoints.

What is meant by ‘fuel remaining’ in this context? There should be at least two methods by which usable fuel remaining can be determined. One can be by subtracting fuel used from the amount known to have been in tanks at engine start, and another by summing the totals shown on gauges for each tank. Results obtained by both methods can then be compared to deliver a reasonably accurate figure. Account should be taken of any fuel quantities that although indicated are unobtainable.

Most flight management systems/guidance computers will depict a ‘fuel remaining’ total figure that can easily be read and recorded alongside or compared with the ‘plog’ predicted value. This low-workload process has merit in that it will not deter the crew from making and recording frequent fuel checks, but it could be misleading in the event that the tanks contain fuel that cannot or should not be used. Failure to cross-check from time to time that the total depicted is truly the sum of the individual tanks could deprive the crew of early warning regarding a fuel leak (from tank or engine) and consequent imbalance, in which case both checklist action (to address the technical problem) and captain’s consideration (to continue or divert) will be necessary.

### 7.7 TO CONTINUE WITH THE FLIGHT PLAN OR TO DIVERT?

Once the engines have been started, usable fuel in the tanks should no longer be thought of as the several different elements that were identified at the planning stage, but as a total amount, all of which is available to keep the engines working until a safe landing can be made.

At any stage after the engines have been started, Contingency Fuel can be permitted to reduce to zero without this alone jeopardising continuation of the flight.

If the total fuel on board is likely to be less than CMR Fuel when the aeroplane is approaching the intended destination aerodrome, the captain does not have to proceed immediately to the planned alternate aerodrome but may – subject to instructions specified in the OM – accept small delays to initiating the final approach. Burning some of CMR Fuel can be acceptable when the traffic and operational conditions at both the destination and alternate aerodromes suggest that the delay will not be long: this is a judgement call for the captain. If, however, it is decided to accept the delay which then subsequently lengthens unacceptably, the next decision must be – if CMR Fuel no longer remains intact – whether to stay or to divert, and to consider declaring an emergency so that air traffic control knows that a request for priority handling will be needed.

Some operators require their captains to declare a ‘PAN’ call at this stage ‘when it is possible that Final Reserve Fuel will not be remaining on landing’ (such as could arise if the decision is made to remain overhead the destination) and a ‘MAYDAY’ later on ‘when it is calculated that Final Reserve Fuel will not be remaining on landing’, as will almost certainly be the case if a decision is made to proceed to the alternate aerodrome leaving the destination overhead with less than CMR Fuel remaining. Remember that in many parts of the world, the use of the word ‘PAN’ is not acknowledged.

### 7.8 ABNORMAL CIRCUMSTANCES

In-flight failures of fuel pumps or other constraints that render fuel unavailable from a tank or tanks, enforced flight at significantly low flight levels or altitudes (increasing fuel burn), and flights such as might be made with the undercarriage down (e.g. inability to raise after take-off) all place fuel management demands upon the captain.

Whenever something unexpected happens like these abnormal events, the captain should still ensure that the fuel remaining is recorded regularly on a log, etc where it can be referred to easily. At such times, the increased hourly fuel burn – read from fuel flow gauges – should be noted, for the original predicted fuel burn may no longer apply. Fuel flow readings can be very useful when making quick calculations of endurance.

In some aeroplanes, abnormal circumstances may cause some indicated fuel quantities to become unavailable. Captains should be alert for this possibility, which may have been mentioned during type conversion or routine refresher training, and could be indicated on abnormal/emergency checklists.

It follows that the captain will at this stage be deciding where to divert, taking into account aircraft weight and runway landing distance requirements (amongst other matters). Running short on fuel is one problem that can be avoided, provided that the decision where to land is taken in good time. It is the unpredictability of what may further complicate the issue that the captain needs to bear in mind: a safe arrival has to be his/her overriding objective. The captain must remember that most modern aircraft have a fully automated fuel management system, but this does not absolve the flight crew from their responsibility to manage the fuel correctly. Initial and Continuation Training should provide the captain with the type-specific competences required.

Finally, a word or two about the Fuel Temperature, as prolonged flight at high altitudes will bring the fuel temperature within the fuel tanks down to close to the fuel freeze point. Captains must ensure that they remain aware of this trend and Operations Manuals must contain the procedures to manage fuel supplies to mitigate potential consequences.

### 7.9 CONCLUSION

Fuel planning and fuel management each require knowledge and application if pitfalls are to be avoided.

For the newly-appointed captain, understanding precisely what is required at the planning stage and checking that all fuel calculations have been done correctly, and knowing how best to manage the flight in both normal and abnormal circumstances, will avoid the potential for in-flight stress whilst helping to promote self confidence.

## SECTION 8 – ACCIDENT AND INCIDENT REPORTING

### 8.1. AIR ACCIDENTS INVESTIGATION BRANCH (AAIB)

8.1.1 Reporting an accident

All reportable accidents are required to be notified to the **UK Department for Transport.**
**UK AAIB 24-hour Accident Reporting telephone line number: +44 (0)1252 512299**

***The legal responsibility for notification of an accident rests first with the commander of the aircraft or, if he be killed or incapacitated, then the operator.***

If the accident occurs on or adjacent to an aerodrome, then the aerodrome authority is also required to notify the accident.

The notification is required to be passed to the Department for Transport (in effect the AAIB) by the quickest means and giving, as far as possible, the following information:

a. In the case of an accident the identifying abbreviation "ACCID" or, in the case of a serious incident, the identifying abbreviation "INCID";

b. the type, model, nationality and registration marks of the aircraft;

c. the names of the owner, operator and hirer (if any) of the aircraft;

d. the name of the commander of the aircraft;

e. the date and time (UTC) of the accident;

f. the last point of departure and the next point of intended landing of the aircraft involved;

g. the position of the accident in relation to some easily defined geographical location;

h. the number of
   i. crew on board and the number killed or seriously injured.
   ii. passengers on board and the number killed or seriously injured.
   iii. other persons killed or seriously injured as a result of the accident.
   iv. the nature of the accident as far as is known.

The person reporting the accident to the AAIB is also required to inform the local police of the accident and the place where it occurred.

Police Forces should also inform the appropriate Civil Aviation Air Traffic Control Centre at West Drayton for accidents occurring in England, and at Prestwick for accidents occurring in Scotland and Northern Ireland.

### 8.2 MANDATORY OCCURRENCE REPORTS (MOR)
### EU-OPS 1.420 Occurrence reporting

Every crew member has a responsibility to report events described in EU-OPS 1.085(b) using the company occurrence reporting scheme detailed in EU-OPS 1.037(a)(2). Mandatory Occurrence Reporting is a requirement under EU-OPS 1.420. Significant risk-bearing incidents detected by FDM will therefore normally be the subject of mandatory occurrence reporting by the crew. If this is not the case then they should submit a retrospective report that will be included under the normal accident prevention and flight safety process without prejudice.

***Reference to the operator's Mandatory Occurrence Reporting scheme will establish what incidents must be reported by a Commander whose ultimate responsibility it is to file an MOR when necessary and offer guidance on how to satisfy the EU-OPS Occurrence reporting requirements.*** The Company MOR Scheme requirements will be found in the Operations Manual and will include all of the following:

***Occurrence Report Forms to be used:***

UK Occurrence Report Form - CA1673 (or its EU OPS equivalent)

UK ATC Occurrence Report Form - CA1261 (or its EU OPS equivalent)

UK Engineering Occurrence Report Form - CA1262 (or its EU OPS equivalent)

***Occurrences required to be reported include:***
Aircraft Operations, Maintenance, Repair and Manufacture-related occurrences

Aircraft flight operations
Aircraft technical
Aircraft maintenance and repair
Ground services and facilities
Air Navigation Services-related occurrences

***Occurrence Reports Dissemination destinations*:**
Occurrence Publications of all of the following:
The UK CAA Safety Investigation and Data Department
The UK Airprox Board (UKAB) via an Aircraft Proximity Hazards (Airprox) Report
The UK CAA Safety Promotion Section - General Aviation Department

***The following extracts are of interest to Flight Crews and aircraft commanders in particular. They are limited to Flight Operations and Aircraft technical matters directly involving aircraft and their Operation.***

8.2.1 Occurrences requiring a Mandatory Report

In deciding whether or not to report an occurrence, it must be determined whether the event meets the definition as specified in EU-OPS.

A reportable occurrence in relation to an aircraft means any incident which endangers or which, if not corrected, would endanger an aircraft, its occupants or any other person. A list of examples of these occurrences appears in Appendix 4. That Appendix provides a handy summary of the types of occurrences that are required to be reported. However, ‘reporters’ are left to determine whether endangerment is a factor and thus determine whether the incident should be reported.

Those occurrences which must always be reported (e.g. fires, uncontained engine failures, critically low fuel states, close proximity between aircraft, etc.) can easily be listed but it is impossible to define precisely every significant hazard which requires reporting. What is judged to be reportable on one class of aircraft may not be so for another one. The absence or presence of a single factor, human or technical, can transform a minor occurrence into a significant hazard or an accident. Judgement by the reporter of the degree of hazard or potential hazard involved is therefore essential in many cases.

Within the above constraints, this Section lists the types of occurrence that are likely to fall within the definition of a reportable occurrence in which case they must therefore be reported. Whilst Appendix 4 lists the majority of occurrences which shall normally be reported, it cannot be completely comprehensive and any other occurrences judged, by those involved, to meet the criteria shall be reported.

## 8.3 REPORTABLE INCIDENTS - AIRCRAFT FLIGHT OPERATIONS

8.3.1 Operation of the aircraft

a. Avoidance manoeuvres:
   i. Risk of collision with another aircraft, terrain or other object or an unsafe situation when avoidance action would have been appropriate;
   ii. An avoidance manoeuvre required to avoid a collision with another aircraft, terrain or other object;
   iii. An avoidance manoeuvre to avoid other unsafe situations.

b. Take-off or landing incidents, including precautionary or forced landings. Such events include under-shooting, over-running or running off the side of runways. Also take-offs, rejected take-offs and landings or attempted landings on a closed, occupied or incorrect runway and runway incursions.

c. Inability to achieve predicted performance during take-off or initial climb.

d. Critically low fuel quantity or inability to transfer fuel or use total quantity of usable fuel.

e. Loss of control (including partial or temporary) regardless of cause.

f. Occurrences close to or above V1 resulting from or producing a hazardous or potentially hazardous situation (e.g. rejected take-off, tail strike, engine-power loss

g. Go around producing a hazardous or potentially hazardous situation.

h. Unintentional significant deviation from airspeed, intended track or altitude (more than 300 ft) regardless of cause.

i Descent below decision height/altitude or minimum descent height/altitude without the required visual.

j. Loss of position awareness relative to actual position or to other aircraft.

k. Breakdown in communication between flight crew "CRM" (crew resource management) or between flight crew and other parties (e.g., cabin crew, air traffic control (ATC) or engineering).

l. Heavy landing - a landing deemed to require a "heavy landing check".

m. Exceedance of fuel imbalance limits.

n. Incorrect setting of an "SSR" (secondary surveillance radar) code or of an altimeter subscale.

o. Incorrect programming of, or erroneous entries into, equipment used for navigation or performance

p. Incorrect receipt or interpretation of radio-telephony messages.

q Fuel system malfunctions or defects, which had an effect on fuel supply and/or distribution.

r. Aircraft unintentionally departing from a paved surface.

s. Collision between an aircraft and any other aircraft, vehicle or other ground object.

t. Inadvertent and/or incorrect operation of any controls.

u. Inability to achieve the intended aircraft configuration for any flight phase (e.g., landing gear and gear doors, flaps, stabilisers, slats etc.).

v. A hazard or potential hazard which arises as a consequence of any deliberate simulation of failure conditions for training, system checks or training purposes.

w. Abnormal vibration.

x. Operation of any primary warning system associated with manoeuvring the aircraft e.g, configuration warning, stall warning (stick shaker), over-speed warning etc. unless:
   (i) the crew conclusively established that the indication was false and provided that the false warning did not result in difficulty or hazard arising from the crew response to the warning; or
   ii) operated for training or test purposes.

y. GPWS (ground proximity warning system)/"TAWS" (terrain awareness and warning system) "warning" when:
   i. the aircraft comes into closer proximity to the ground than had been planned or anticipated; or
   ii. the warning is experienced in instrument meteorological conditions or at night and is established as having been triggered by a high rate of descent (mode 1); or
   iii. the warning results from failure to select landing gear or landing flaps by the appropriate point on the approach (mode 4); or
   iv. any difficulty or hazard arises or might have arisen as a result of crew response to the "warning" e.g. possible reduced separation from other traffic. This could include warning of any mode or type i.e. genuine, nuisance or false.

z. GPWS/TAWS "alert" when any difficulty or hazard arises or might have arisen as a result of crew response to the "alert".
   i. ACAS (air collision advisory system) "RA" (resolution advisories).
   ii. Jet or prop blast incidents resulting in significant damage or serious injury.
   iii. Landing at the wrong airfield.

8.3.2 Emergencies

a. Fire, explosion, smoke or toxic or noxious fumes, even though fires were extinguished.

b. The use of any non-standard procedure by the flight or cabin crew to deal with an emergency when:
   i. the procedure exists but is not used;
   ii. the procedure does not exist;
   iii. the procedure exists but is incomplete or inappropriate;
   iv. the procedure is incorrect;
   v. the incorrect procedure is used.

c. Inadequacy of any procedures designed to be used in an emergency, including when being used for maintenance, training or test purposes.

d. An event leading to an emergency evacuation.

e. Depressurisation.

f. The use of any emergency equipment or prescribed emergency procedures in order to deal with a situation.

g. An event leading to the declaration of an emergency ("Mayday" or "PAN").

h. Failure of any emergency system or equipment, including all exit doors and lighting, to perform satisfactorily, including when being used for maintenance, training or test purposes.

i. Events requiring any use of emergency oxygen by any crew member.

8.3.3 Crew incapacitation

a. Incapacitation of any member of the flight crew, including that which occurs prior to departure if it is considered that it could have resulted in incapacitation after take-off.

b. Incapacitation of any member of the cabin crew which renders them unable to perform essential emergency duties.

8.3.4 Injury

Occurrences that have or could have led to significant injury to passengers or crew but which are not considered reportable as an accident.

8.3.5 Meteorology

a. A lightning strike which resulted in damage to the aircraft or loss or malfunction of any essential service.

b. A hail strike which resulted in damage to the aircraft or loss or malfunction of any essential service.

c. Severe turbulence encounter, an encounter resulting in injury to occupants or deemed to require a "turbulence check" of the aircraft.

d. A wind-shear encounter.

e. Icing encounter resulting in handling difficulties, damage to the aircraft or loss or malfunction of any essential service.

f. Volcanic Ash encountered and resulting in damage to the aircraft and/or systems.

8.3.6 Security

a. Unlawful interference with the aircraft including a bomb threat or hijack.

b. Difficulty in controlling intoxicated, violent or unruly passengers.

c. Discovery of a stowaway.

8.3.7 Other occurrences

a. Repetitive instances of a specific type of occurrence which in isolation would not be considered "reportable" but which due to the frequency with which they arise, form a potential hazard.

b. Any bird strike, particularly one which resulted in damage to the aircraft or loss or malfunction of any essential service.

c. Wake-turbulence encounters.

d. Any other occurrence of any type considered to have endangered or which might have endangered the aircraft or its occupants on board the aircraft or persons on the ground.

## 8.4 AIRCRAFT TECHNICAL

8.4.1 Structural

***Not all structural failures need to be reported. Engineering judgment is required to decide whether a failure is serious enough to be reported. The following examples can be taken into consideration***:

a. Damage to a "PSE" (principal structural element) that has not been designated as damage-tolerant (life-limited element). PSEs are those which contribute significantly to carrying flight, ground, and pressurisation loads, and the failure of which could result in a catastrophic failure of the aircraft;

b. Defect or damage exceeding admissible damages to a PSE that has been designated as damage-tolerant;

c. Damage to or defect exceeding allowed tolerances of a structural element, the failure of which could reduce the structural stiffness to such an extent that the required flutter, divergence or control reversal margins are no longer achieved;

d. Damage to or defect of a structural element, which could result in the liberation of items of mass that may injure occupants of the aircraft;

e. Damage to or defect of a structural element, which could jeopardise proper operation of systems. See paragraph 2.2 below;

f. Loss of any part of the aircraft structure in flight.

8.4.2 Systems

The following general criteria applicable to all systems are proposed:

a. Loss, significant malfunction or defect of any system, subsystem or set of equipment when standard operating procedures, drills etc. could not be satisfactorily accomplished;

b. Inability of the crew to control the system, for example:
   - i) un-commanded actions,
   - ii) incorrect and/or incomplete response, including limitation of movement or stiffness,
   - iii) runaway,
   - iv) mechanical disconnection or failure;

c. Failure or malfunction of the exclusive function(s) of the system (one system could integrate several functions);

d. Interference within or between systems;

e. Failure or malfunction of the protection device or emergency system associated with the system;

f. Loss of redundancy of the system;

g. Any occurrence resulting from unforeseen behaviour of a system.

h. For aircraft types with single main systems, subsystems or sets of equipment loss, significant malfunction or defect in any main system, subsystem or set of equipment.

i. For aircraft types with multiple independent main systems, subsystems or sets of equipment: the loss, significant malfunction or defect of more than one main system, subsystem or set of equipment.

j. Operation of any primary warning system associated with aircraft systems or equipment unless the crew conclusively established that the indication was false, provided that the false warning did not result in difficulty or hazard arising from the crew response to the warning;

k. Leakage of hydraulic fluids, fuel, oil or other fluids which resulted in a fire hazard or possible hazardous contamination of aircraft structure, systems or equipment, or risk to occupants;

l. Malfunction or defect of any indication system when this results in the possibility of misleading indications to the crew;

m. Any failure, malfunction or defect if it occurs at a critical phase of the flight and is relevant to the system operation;

n. Significant shortfall of the actual performances compared to the approved performance which resulted in a hazardous situation (taking into account the accuracy of the performance-calculation method) including braking action, fuel consumption etc.;

o. Asymmetry of flight controls; e.g. flaps, slats, spoilers etc.

*The Appendix to this Schedule gives a list of examples of reportable occurrences resulting from the application of these general criteria to specific systems. A table summarising the occurrences that are listed in this Section may also be found in Appendix 4 of this Specialist Document.*

8.4.3 Propulsion (includes engines, propellers & rotor systems) and APU (auxiliary power unit).

a. Flameout, shutdown or malfunction of any engine.

b. Overspeed or inability to control the speed of any high-speed rotating component (for example: APU, air starter, air cycle machine, air turbine motor, propeller or rotor).

c. Failure or malfunction of any part of an engine or power-plant resulting in any one or more of the following:
   i. non-containment of components/debris;
   ii. uncontrolled internal or external fire, or hot gas breakout;
   iii. thrust in a direction different from that demanded by the pilot;
   iv. thrust-reversing system failing to operate or operating inadvertently;
   v. inability to control power, thrust or revolutions per minute;
   vi. failure of the engine mount structure;
   vii. partial or complete loss of a major part of the power-plant;
   viii dense visible fumes or concentrations of toxic products sufficient to incapacitate crew or passengers;
   ix. inability, by use of normal procedures, to shutdown an engine;
   x. inability to restart a serviceable engine.

d. An uncommanded thrust/power loss, change or oscillation which is classified as a 'Loss of thrust or power control' (LOTC):
   i. for a single-engine aircraft; or
   ii. where it is considered excessive for the application; or
   iii. where this could affect more than one engine in a multi-engine aircraft, particularly in the case of a twin-engine aircraft; or
   iv. for a multi-engine aircraft where the same, or similar, engine type is used in an application where the event would be considered hazardous or critical.

e. Any defect in a life-controlled part causing its withdrawal before completion of its full life.

f. Defects of common origin that could cause an in-flight shut-down rate so high that there is the possibility of more than one engine being shut down on the same flight.

g. An engine limiter or control device failing to operate when required or operating inadvertently.

h. Exceedance of engine parameters; and Foreign Objects Damage (FOD).

8.4.4 Propellers and transmission

a. Failure or malfunction of any part of a propeller or power-plant resulting in any one or more of the following:
   i. an overspeed of the propeller;
   ii. the development of excessive drag;
   iii. a thrust in the opposite direction to that commanded by the pilot;
   iv. a release of the propeller or any major portion of the propeller;
   v. a failure that results in excessive imbalance;
   vi. the unintended movement of the propeller blades below the established minimum in-flight low-pitch position;
   vii. an inability to feather the propeller;
   viii. an inability to change propeller pitch;
   ix. an un-commanded change in pitch;
   x. an uncontrollable torque or speed fluctuation; and
   xi. the release of low-energy parts.

Rotors and transmission

b. Damage or defect of main rotor gearbox/attachment which could lead to in-flight separation of the rotor assembly and/or malfunctions of the rotor control.

c. Damage to tail rotor, transmission and equivalent systems.

APUs

d. Shut down or failure when the APU is required to be available by operational requirements, e.g., ETOPS, "MEL" (minimum equipment list).

e. Inability to shut down the APU.

f. Overspeed.

g. Inability to start the APU when needed for operational reasons.

8.4.5 Human factors

Any incident where any feature or inadequacy of the aircraft design could have led to an error of use that could contribute to a hazardous or catastrophic effect.

8.4.6 Other occurrences

a. Any incident where any feature or inadequacy of the aircraft design could have led to an error of use that could contribute to a hazardous or catastrophic effect.

b. An occurrence not normally considered as reportable (e.g., furnishing and cabin equipment, water systems), where the circumstances resulted in endangering the aircraft or its occupants.

c. A fire, explosion, smoke or toxic or noxious fumes.

d. Any other event which could endanger the aircraft, or affect the safety of the occupants of the aircraft, or people or property in the vicinity of the aircraft or on the ground.

e. Failure or defect of passenger-address system resulting in loss of, or inaudible, passenger address system.

f. Loss of pilot seat control during flight.

**8.5 COROLLARY**

***The sub-paragraphs that follow, give examples of reportable occurrences resulting from the application of the general criteria to specific systems, listed in 8.4 of this Section (Aircraft technical)l. Also see Appendix 4 for a tabular summary of the following lists:***

8.5.1 Air conditioning/ventilation

a. Complete loss of avionics cooling;
b. Depressurisation.

8.5.2 Auto-flight system

a. Failure of the auto-flight system to achieve the intended operation while engaged;
b. Failure of any auto-flight system disconnect device;
c. Uncommanded auto-flight mode change.
d. Significant reported crew difficulty to control the aircraft linked to auto-flight system functioning;

8.5.3 Communications

a. Total loss of communication in flight;
b. Failure or defect of the passenger-address system resulting in loss of or inaudible passenger address.
**c.** Breakthrough/Loss of Communications fidelity caused by interference from Passenger Electronic Devices.

8.5.4 Electrical system

a. Loss of one electrical distribution system (AC/DC);
b. Total loss or loss of more than one electrical generation system;
c. Failure of the back up (emergency) electrical generation system.

8.5.5 Cockpit/Cabin/Cargo

a. Pilot seat control loss during flight;
b. Loss of retention capability of the cargo loading system;
c. Failure of any emergency system or equipment, including emergency evacuation signalling system, all exit doors, emergency lighting, etc.

8.5.6 Fire protection system

a. Fire warnings, except those immediately confirmed as false;
b. Absence of warning in case of actual fire or smoke;

c. Undetected failure or defect of fire/smoke detection/protection system, which could lead to loss or reduced fire detection/protection.

8.5.7 Flight controls

a. Asymmetry of flaps, slats, spoilers, etc;
b. Flight control surface runaway;
c. Flight control surface vibration felt by the crew;
d. Mechanical flight control disconnection or failure;
e. Limitation of movement, stiffness or poor or delayed response in the operation of primary flight control systems or their associated tab and lock systems;
f. Significant interference with normal control of the aircraft or degradation of flying qualities.

8.5.8 Fuel system

a. Fuel quantity indicating system malfunction resulting in total loss or wrong indication of fuel quantity on board;
b. Leakage of fuel which resulted in major loss, fire hazard, significant contamination;
c. Malfunction or defects of the fuel jettisoning system which resulted in inadvertent loss of significant quantity, fire hazard, hazardous contamination of aircraft equipment or inability to jettison fuel;
d. Fuel system malfunctions or defects which had a significant effect on fuel supply and/or distribution;
e. Inability to transfer or use total quantity of usable fuel.

8.5.9 Hydraulics

a. Loss of one hydraulic system (ETOPS only);
b. Failure of the isolation system;
c. Loss of more than one hydraulic circuit;
d. Failure of the back-up hydraulic system;
e. Inadvertent ram air turbine extension.

8.5.10 Ice detection/protection system

a. Undetected loss or reduced performance of the anti-ice/de-ice system;
b. Loss of more than one of the probe-heating systems;
c. Inability to obtain symmetrical wing de-icing;
d. Crew vision significantly affected;
e. Abnormal ice accumulation leading to significant effects on performance or handling qualities.

8.5.11 Indicating/warning/recording systems

a. Malfunction or defect of any indicating system when the possibility of significant misleading indications to the crew could result in an inappropriate crew action on an essential system;
b. Loss of a red warning function on a system;
c. For glass cockpits: loss or malfunction of more than one display unit or computer involved in the display/warning function.

8.5.12 Landing gear system/brakes/tyres

a. Brake fire;
b. Significant loss of braking action;
c. Asymmetrical braking action leading to significant path deviation;
d. Failure of the landing gear free fall extension system (including during scheduled tests);
e. Unwanted landing gear or gear doors extension/retraction;
f. Multiple tyres burst.
g. Uncontained tyre/wheel/brake damage that results in the aircraft or one of its systems becoming damaged.

8.5.13 Navigation systems (including precision approach systems) & air data systems

a. Total loss or multiple navigation equipment failures
b. Total or multiple air data system equipment failures
c. Significant misleading indications
d. Significant navigation errors attributed to incorrect data or a database coding error

e. Unexpected deviations in lateral or vertical path not caused by pilot input

f. Problems with ground navigational facilities leading to significant navigation errors not associated with transitions from inertial navigation mode to radio navigation mode.

8.5.14 Oxygen for pressurised aircraft

a. Loss of oxygen supply in the cockpit

b. Loss of oxygen supply to a significant number of passengers (more than 10 %), including when found during maintenance or training or testing.

8.5.15 Bleed air system

a. Hot bleed air leak resulting in fire warning or structural damage

b. Loss of all bleed-air systems

c. Failure of bleed air leak detection system.

**A table summarising the occurrences that MUST be reported may be found in Appendix D of this Specialist Document.** Further information on Mandatory Occurrence Reporting requirements may be found on the UK CAA Web site at: **www.caa.co.uk**


© Captain Ralph Kohn FRAeS

… And use your checklists meticulously; both on normal operations and when things go pear-shaped

© Captain Ralph Kohn FRAeS

Well done captain… you are now a B747 commander

**END OF PART 2 - LEGAL**

# PART 3 – FLIGHT MANAGEMENT

## CONTENTS



Thought to ponder over …

**A pilot can make a mistake … but a crew MUST NOT**

… offered by Captain A C ‘Mac’ McLauchlan (BA B747 ret)

**PART 3 – FLIGHT MANAGEMENT - PREAMBLE**

**IN COMMAND AT ALL TIMES**
by Captain C.N.WHITE FRAeS
(With items contributed as indicated)



**IN COMMAND AT ALL TIMES - Albatross flying in South Georgia**

**PREAMBLE**

The move from the right hand seat to the left hand seat can be quite traumatic if you have not been given the opportunity to assist in making decisions while you were a First Officer. This point is worth remembering because an important task that any good captain should undertake is to further the development and give experience to the First Officers that they fly with. More will be said about this later on. What then is a captain? A captain is the person who has been given the authority by the company that they work for, to be responsible for the safety and well being of the aircraft that they fly and all that is contained in that aircraft, from the airfield of departure to the destination airfield. If you as a captain only do so, is this sufficient in this day and age? Frankly NO, much more should be given to-day by the person who is in overall command of the aircraft. Notice that the word “Command” has now appeared.

The modern sophisticated multi-crew aircraft is commanded by an “Aircraft Commander.” So let us look then as to what is required of an aircraft commander. The aircraft commander takes a global overview of the whole operation and has a greater “Situational Awareness” than the average captain. NASA defines situational awareness as *“Awareness of all that is going on, both inside and outside the aircraft”.* This will include having the best interests of the company at heart. Not just getting the aircraft from A to B. Therefore, a greater understanding of the company in general and how it operates are needed. Get to know the various departments, understand their problems, which in turn may give you a better insight into problems that occur down the route. By doing this you will make better decisions and acquire “Respect.” Remember that authority is given to you, but respect must be earned.

**SECTION 1** - **WHAT MAKES A GOOD AIRCRAFT COMMANDER?**

What sort of image do you wish to create as an aircraft commander? Below is a list of some of the many undesirable images, which a good commander would not want to be associated with.

| | |
|---|---|
| ● Aggressive | ● Demeaning |
| ● Arrogant | ● Dogmatic |
| ● Boring | ● Dismissive |
| ● Condescending | ● Embarrassing |
| ● Domineering | ● Unhygienic |

Look at yourself in the mirror occasionally and see if any of these items are appearing, then take action accordingly. To be a good commander it takes an effort to remain ‘in the slot’. Listen to feedback which will occasionally be given to you in various forms. Later on, more will be said about “Feedback”.

A good question to ask yourself in order to set your standards is: “What sort of aircraft commander would I like to be seen as, and Why?”

Having looked at the “Bad Images,” let us now look at some of the “Good Images” on which to build your image :

| | | | |
|---|---|---|---|
| ● Approachable | ● Encourages | ● Good operator | ● Smart |
| ● Communicates | ● Fair | ● Non-judgmental | ● Takes responsibility |
| ● Confident | ● Flexible | ● Open / Friendly | ● Team builder |
| ● Consistent | ● Good listener | ● Positive | ● Technically competent |
| ● Delegates | ● Humble | ● Relaxed | ● Uses appropriate authority |

With the above images in mind, you can now start developing your own image. Do it slowly and build on each item. As you gain experience as a commander, so your stature and respect will increase. Do not expect to be an instant success, be safe and sure, emulate those commanders that you have respect for and one day you will be a very good commander.

**SECTION 2 - COMMUNICATION**

To be a good and effective aircraft commander, it is a necessary requirement to be able to communicate with others, whether they are your crew or not. At this point it is necessary to move at a tangent and ask the simple question “Who is your Crew?” Your crew are the people that you are going to communicate with the most. The stock answer to this is: -

1. Myself.
2. The First Officer.
3. The Cabin Crew.

Well the answer is partially correct, your Crew actually consists of a very much larger group than perhaps you realise. They are: -

1. Yourself.
2. The First Officer.
3. The cabin crew.
4. The flight planning dispatcher.
5. The bus driver, taking you to the aircraft.
6. The aircraft dispatcher.
7. The ground engineering crew.
8. The loaders.
9 Do not forget “Your Company”. After all, it is coming with you.

You will see that there are numerous people that you are required to communicate with just to dispatch your aircraft.

There are three main ways that humans communicate with one another:

1. Verbally: The words that we use.
2. Vocally: The expression and intonation that we put into those words.
3. Visually: The body language that we use to express ourselves.

The effectiveness of each of the above methods of communication in a normal social situation is deemed to be:

1. Verbal : 7%
2. Vocal : 38%
3. Visual : 55%

When communicating on the ground with other departments or ground crew, be careful with body language. It would be useful to you if, as the commander, you are looked upon as someone that they would like to respect. Do not let your body language come across as aggressive because you are feeling slightly unsure of yourself. Remember that if you are relaxed, others will come to your aid if you need help. Also, be aware that first impressions make a big impact. So both on and off duty be smart in your dress and appearance, since this makes a powerful statement by itself and has a huge bearing as to how you are received and perceived.

On the flight deck, there is very little “Visual” communication. In other words, the major communication element has been reduced by 50%; a huge amount. The most effective method of communication now rests on your “Vocal” communication. It will be noted that this is at least five times greater than the last remaining method “Verbal.” So a good commander must be very aware of the expression and intonation that they use. The way something is emphasised in a ‘Social’ situation off the flight deck, may have disastrous consequences if used in the same way on the flight deck.

The verbal element must therefore be made more important than 7%. To do this, a good commander will use :

1. Standard phraseology
2. Precise language
3. Precise commands – careful with the intonation.
4. Clear statements of intent.
5. Positive suggestions.
6. Use acknowledgement and read back.
7. Do not let social barriers get in the way.

One of the most powerful ways of communicating is to *"LISTEN."* Do not crowd others with your ideas. Hear what they have to say, it may be important as well as useful. See where they are coming from; make them feel involved, this is part of being a good leader, more about leadership later. Remember that good communication is a two-way event, so you need to be on the same "Frequency" with the person that you are communicating with.

## SECTION 3 - LEADERSHIP

Some people are born leaders and remain so, while others learn to be good leaders. What therefore is the definition of a leader?

"A Leader is a person who has the power to "CHANGE" the thought and behaviour of others in a desired way."

Leadership, like respect, is earned; whereas authority is assigned.

### 3.1 LEADERSHIP STYLES AVAILABLE TO AN AIRCRAFT COMMANDER:

1. *Authoritarian leadership* - directing, precise orders, monitoring of performance.
2. *Integrating leadership* - cooperative, consult, take part, sharing of ideas, embolden to decide.
3. *Participative leadership* - convince, explicate, illustrate decisions, questions, chance for clarification,.
4. *Leadership by delegation* - non-leading, delegate responsibility for decisions and execution, hand-over.

Command style should be mainly driven by the level of competence/maturity of the part of the crew which should be led. Sliding along the scale is necessary for captains but especially required for trainers/instructors, who will have to adapt to the development of their trainees. Clearly, an immature crew requires more direction, a mature crew just delegation.

More will be said about these styles in section ***6. Prioritisation***, when Decision making and Leadership are combined.

### 3.2 LEADERSHIP IS MADE UP OF TWO BASIC INGREDIENTS :

1. The ability to motivate others and gain their respect.
2. The ability to make good decisions and be supported by those around you.

These two very important items are analysed individually in ***'4. Motivation'*** and in '***5. Decision Making'***

## SECTION 4 – MOTIVATION

Motivation is that which induces a person to act, in other words get them off their Bum and get them thinking and reacting, preferably on their own, without any further inducement, which in turn they do voluntarily from then on.

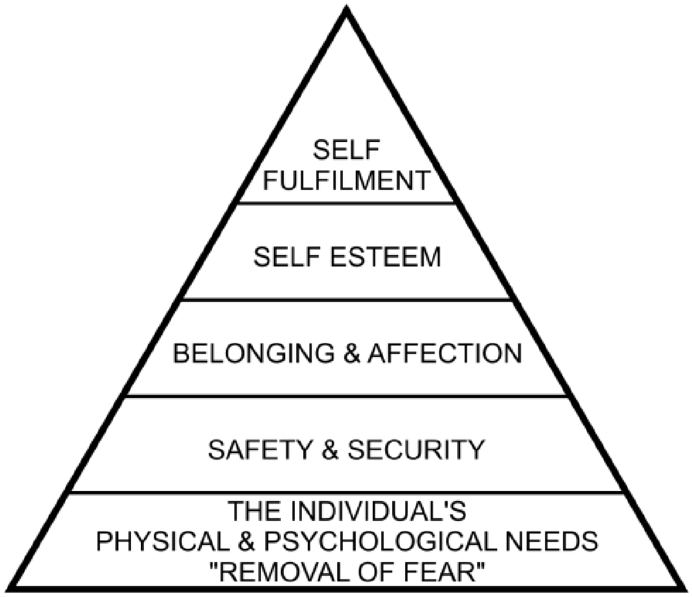
Abraham Maslow (1908 - 1970), who chaired the psychology department at 'Brandeis' in the United States, did much research on motivation and human psychology. It was he who invented "Maslow's Triangle." He looked into the needs of the individual and then related these to every day life. The basic requirements of the individual are called the basic human needs, which are

### 4.1 FOOD – WATER – SHELTER.

A pilot already has "Food – Water – Shelter" since he or she has a stable job which in turn provides the basic essentials of life. Once these three items have been acquired, the individual will increasingly start to look for safety in the job. From this point on we can now use the triangle to the aircraft commander's benefit, since we can assume that the basic human needs of the first officer have been achieved.

Let us assume that the commander has met a first officer for the very first time and that they are going to fly as a crew. This commander needs to get the first officer "On Side" in order to have a successful day. In the diagram below, you will see that it is a brick-building exercise for the commander.

**MASLOW'S TRIANGLE**




Let us look at each level in the triangle: -

4.1.1 *The Individual's Physical & Psychological Needs* – Make the first-officer feel comfortable. You must be approachable and encouraging, by doing this, you will be removing any fear. This will make the first officer feel secure and not threatened.

4.1.2 *Safety and Security* – encourage the first officer to ask questions, be a good listener. This increases the feeling of security. The first officer is now in a good comfort zone. The first officer feels safe and does not have to look over his or her shoulder.

4.1.3 *Belonging and Affection* – The first officer will begin to feel that he or she now belongs to a team, which gives a sense of well being and enjoyment for the task. There is no longer anxiety and loneliness.

4.1.4 *Self-Esteem* – Now that the first officer is part of a team, they enjoy it. He or she feels that their input is worthwhile. They are encouraged to do even better.

4.1.5 *Self-Fulfilment* – They now are definitely part of a good team and want to give you all the support that they can, to make it a winning team.

As aircraft commander, you have now achieved your objective by having someone alongside of you, who is going to look after you. The more you delegate the more help you will receive and the less stress and worry you will have. What could be better? Safety has been enhanced and the day is running smoothly. The basis of good leadership is *Listen, Motivate, Involve others* and be positive at all times. You will now see how "Motivation" is linked so closely to "Leadership." The other item in Leadership is "Decision Making."

**SECTION 5 - DECISION MAKING**

In recent years, the "Decision Making" technique has changed. In aviation, decisions were made in the past by one person, the aircraft commander, calling on his wealth of experience. Such commanders were "Solo Operators." These "Sky Gods" as referred to by Robert Gandt in his book on the fall of Pan Am the now defunct PAA (Pan American World Airways), did everything themselves and the first officer was metaphorically there to carry the paper work and to raise and lower the undercarriage. These commanders made some good decisions and also some very bad decisions as they had not taken all the facts into account, by not asking other members of the crew for their views. Crews were also too frightened to speak-up because of fear instilled by the chain of command. Today, things have changed dramatically. The commander is still responsible for what happens, but now has many ways of achieving the desired goal, by discussing with the crew the various options available. It will reduce the stress on the commander and broaden the available alternatives with crew input.

Let us look at some of the tools available to an aircraft commander and crew, in order that a good decision can be made. There are a couple of mnemonics that are used in aviation to assist in decision-making. These are "GRADE" as used by the majority of airlines and "DODAR" as used by a few operators only. Both philosophies achieve the same goal. For ease of reference, both philosophies are listed to allow immediate and meaningful comparison of differences. Note the similarity in end-result.

| **GRADE** stands for | **DODAR** stands for |
|---|---|
| a. **G**ather. | a. **D**iagnose. |
| b. **R**eview. | b. **O**ptions. |
| c. **A**nalyse Alternative. | c. **D**ecide. |
| d. **D**ecide & Do. | d. **A**ssign. |
| e. **E**valuate. | e. **R**eview. |

We will analyse **GRADE.** Looking at each stipulation in turn:

a. **Gather**
   i. Gather all the information available.
   ii. Take all the time available, do not rush.

b. **Review**
   i. Sort and check the information.
   ii. Give it a priority.
   iii. Resolve ambiguities – First filter.
   iv. What is the situation now?
   v. How should it be?
   vi. Discard irrelevant information – Second filter.

c. **Analyse Alternatives**
   i. Look for alternatives
   ii. Discard irrelevant information – Third filter
   iii. Look for route to achieve your objective.

d. **Decide and Do**
   i. Make a decision– get as much help as possible from your crew.
   ii. Act accordingly.
   iii. Doing might mean "Do nothing" – if it is not 'broke', do not break it.
   iv. Delegate – do not try to do everything yourself.

e. **Evaluate**
   i. Check the outcome. Is the problem cured?
   ii. Check that you have achieved the objective that you wanted.
   iii. Get "Feedback" from the crew.
   iv. Start GRADE again to check all eventualities.

*The above mnemonic will help you and the crew slow down and explore all the possibilities that are available on the day.*

**Good decision makers**
- Delegate task responsibilities.
- Involve all resources. They get information from all possible sources.
- Communicate what they expect to see.
- Recognise the responsibilities of authority.
- Choose appropriate behaviour.

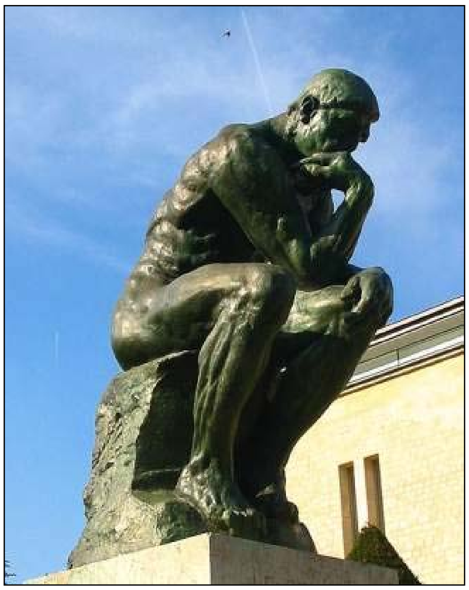
**Whereas poor decision makers**
- Over-control.
- Focus only on the task and not on the overview.
- Distance themselves from the crew.
- Avoid conflict. Occasionally you have to correct someone.
- Behave inconsistently.
- Jump to conclusions, without the necessary evidence.

Decision-making requires practice, which is not readily obtainable today, since the modern commercial aircraft is so reliable. In fact, some people have gone through their flying career having rarely if ever, had to open the Quick Reference Handbook (QRH), other than in the simulator. So how does the modern day co-pilot gain experience if there are no incidents? The obvious way to assist in the development of decision making and experience, is to make your own decision quietly to yourself, before the captain declares the final decision. See if your decision is the same; if not, why not? You may not have taken into account some small item that his or her experience assisted in making the decision which you can learn from.

The art of gaining experience is a solo project that you have to work on by yourself. You really need to start when you obtain the position as co-pilot in your first job. When you are flying, ask yourself ***"WHAT IF"***. For example, as you approach the Alps or Pyrenees, "***What if*** I had an engine failure?" Mentally complete the recall actions - get the check-list out (Quietly and to yourself) go through it. Think out the actions - what is my drift down altitude - what is my MSA? - get your route information manual out and go through it - must I turn back or can I can continue with the terrain clearance - have I got sufficient fuel at a lower altitude if I continue? If I turn back which is the most suitable airfield to divert to - what are the weather conditions at the diversion field - what would I tell the cabin crew - when would I tell the cabin crew? If the captain is not otherwise engaged, ask for his or her opinion, what would he or she have done in this situation, but NOT until you have completed and made YOUR own decision, otherwise you are wasting time. This will help you gain experience in decision making as well as greatly increasing your operational route experience and increasing your own confidence.

Each sector you fly, think of something like this, or a medical emergency, a total electrical failure, or an emergency descent when over high terrain. In effect, work you way through the QRH checklist and tie it in with the terrain or weather conditions or area that you are operating in. By doing this you will build up a huge amount of experience. If and when something occurs, it will not come as a shock, since you have already thought it through. There will be less stress and the job will be completed much more safely. You will develop into a relaxed and competent commander in waiting. Think it through then make your decision and stick to it.

**The Thinker – Statue by Auguste Rodin**



Wikimedia Commons – PD photo by Pufacz

One of Auguste Rodin's most famous sculptures is The Thinker Statue, a piece originally conceived to be part of another work. The Thinker was part of a commission by the Museum of Decorative Arts in Paris to sculpt a monumental door based on The Divine Comedy of Dante. Each of the statues in the piece represented one of the main characters in the epic poem.

Initially named the 'The Poet', *The Thinker* statue was intended to represent Dante himself at the top of the door reflecting on the scene below. However, we can speculate that Rodin thought of the figure in broader, more universal terms. The Thinker is depicted as a man in sober meditation battling with a powerful internal struggle. The unique pose with hand to the chin, right elbow to the left knee, and crouching position allows the statue to survey the work with a contemplative feel.

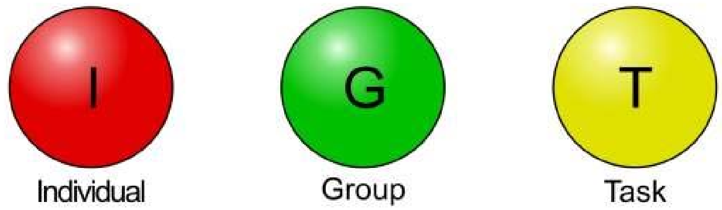
Source AVweb

**What-if they had diverted earlier?**

## SECTION 6 - PRIORITISATION

### 6.1 DECISION MAKING

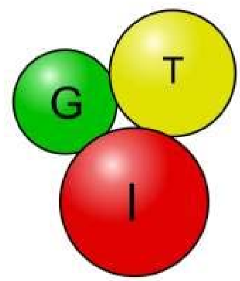
Successful decision-making is also helped by “Prioritisation.” This is where you organise your mind in such a way that you develop an order in which things must be done if there are multiple items to be actioned. By doing this you greatly reduce stress, not only for yourself, but also the crew. Here there is a helpful diagram of trying to keep three balls in the air. This technique is usually used when airborne. Each ball has a greater and lesser importance at different times during the decision-making. Each ball has a name to it as well. These balls change size as their importance changes. The more important the item the bigger the ball is. Graphic was developed from work by John Adair




**Let us take a situation. While on a flight from A to B, one of your passengers needs urgent medical attention.**

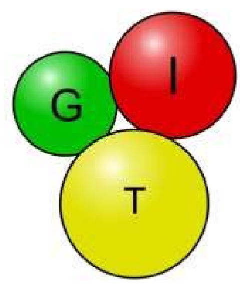
**1. Passenger needs help**

The **INDIVIDUAL’S** need for medical attention on the aircraft has priority over the **TASK,** flying the aircraft or the needs of the **GROUP.** The aircraft is in a safe condition and the passengers **(GROUP)** are comfortable.



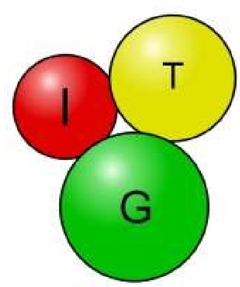

**2. Decision to divert**

The new **TASK** takes precedence involving diversion to an airfield with medical facilities. The **INDIVIDUAL** is being looked after and the passengers **(GROUP)** are still comfortable.




**3. On the Ground at the diversion airfield**

With the patient **(INDIVIDUAL)** in medical care and the **TASK** achieved, that is the diversion completed and the aircraft is safely on the ground, the **GROUP,** that is the other passengers, now become dominant.




Graphics adapted from work by John Adair

One can see from the above, that there is a definite order of priority of doing things

1. First, get the Passengers taken care-of by the Cabin Crew.
2. Second, do a GRADE and decide whether to divert or continue to destination.
3. Third, if you divert, then the passengers group becomes the priority. They need information and care.

6.1.2 Decision-making in anger

An example of prioritising is well demonstrated by this DC-8 captain's experience

Smell smoke? … Better land NOW.

The crew were operating this UPS DC-8-70 from Atlanta to Philadelphia, at around midnight on 2 February 2006. The crew first smelt smoke 23 minutes prior to scheduled landing and declared an emergency. The **SMOKE/FIRE** warning light illuminated three minutes prior to landing. The aircraft burst into flames upon an emergency landing in Philadelphia. The crew evacuated through the cockpit windows using escape ropes. They were examined for smoke inhalation and released. It was a total hull loss with zero reportable injuries. Two known pieces of Hazardous Material (HAZMAT) were on board, amyl methyl-ketone and tire repair kits. The crew did a brilliant, by-the-book job of saving their own lives. Note that the Captain elected to stop on the runway, to allow fully unrestricted access to rescue and fire fighting equipment.

PRIORITIES:

1. Declared an Emergency.
2. Turned the aircraft towards the nearest suitable runway.
3. Completed the checks.
4. Landed as soon as possible.
5. Stayed on the runway:
    a. To evacuate as quickly as possible.
    b. To give the emergency services a hard standing area.


Photo © Paul Kanagie

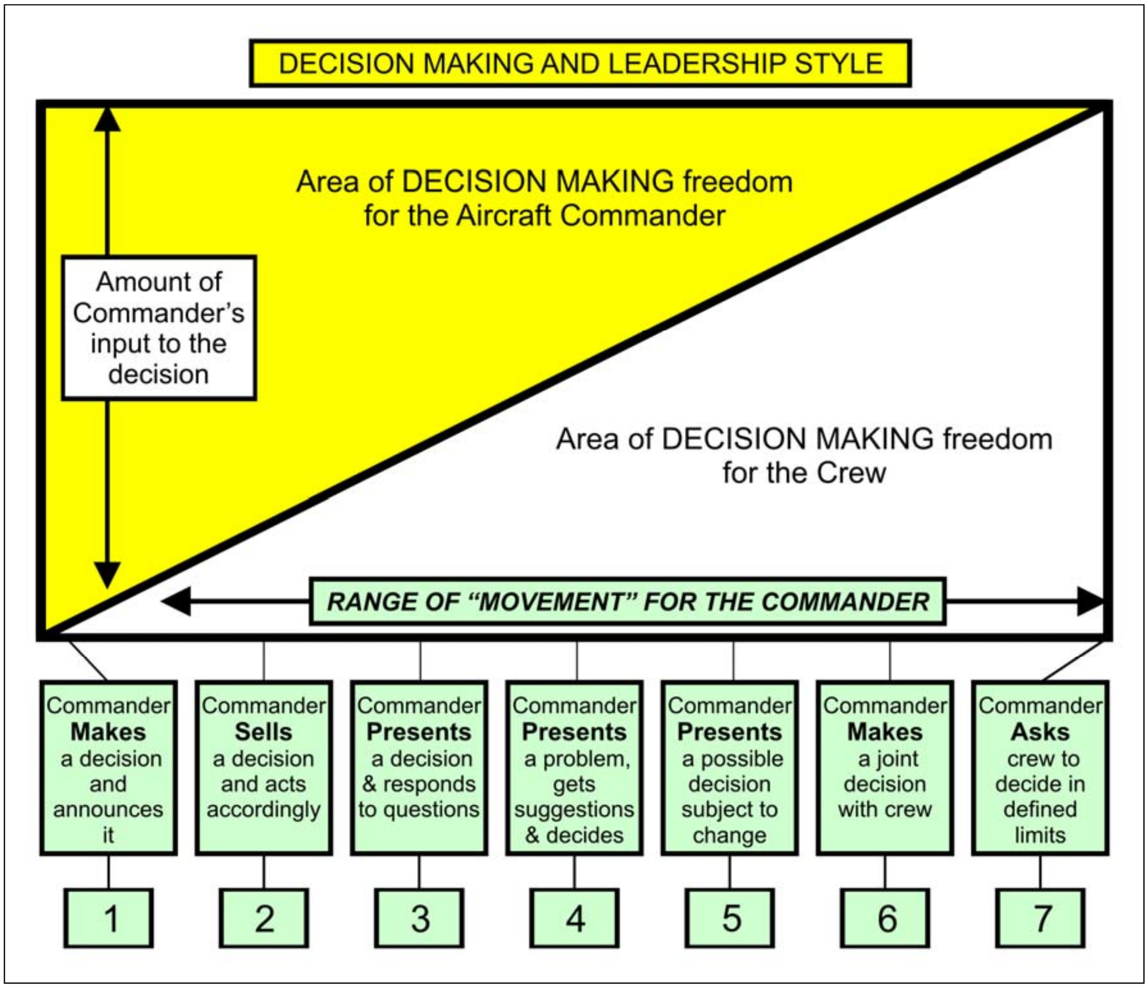
**DC-8 at Philadelphia following an in-flight fire on 2 February 2006**

## 6.2 DECISION MAKING AND LEADERSHIP STYLE

Combining "Prioritisation" with GRADE, you will end up with good decisions every time, providing you involve your crew. Let us now look at the link between Decision Making and Leadership and see how the two combine.

The table below is divided into two triangles. Giving the aircraft commander space to move from total autocracy where the commander alone makes the decision to what looks at first sight, virtually no authority at all with no decision making input at all.

The vertical area in the shaded yellow triangle is proportional to the power that the aircraft commander has in the decision-making and the style that is used to achieve the end result. The commander will have to slide back and forth across the scale at the bottom of the diagram, to achieve the decision required for the occasion. For example:




Developed from a BA training graphic

We now need to diagnose each box and see the impact that the style has on the decision.

1. This is the commander deciding only with no crew input. For example, on reaching Decision Height the response to the challenge "Decide" is 'Land' or 'Go Around'. It is cut and dried.
2. The commander does most of the decision making with a small amount of support, such as when flying an ILS on limits, with a strong cross-wind. The aircraft is bouncing around and is difficult to control; the commander says aloud "I do not like this" and the first officer replies, "I agree," to which the commander says "Go Around." The need for a go around was being sold to the first officer.
3. In this situation, the commander has made the decision and enquires if everyone understands the decision.
4. This one is almost the same as the previous, with the exception that the commander listens to suggestions, but the commander makes the final decision.
5. Here the commander comes up with a possible solution, but is hoping for additional ideas from the crew to assist in the final decision.
6. The crew and commander discuss the possibilities and come up with a joint decision.
7. In this scenario, the commander hands-over completely the decision making to the crew, within defined limits. For example, when on a night-stop, the commander asks: "Where shall we eat tonight?" Note that the commander has laid down the limitations, that is, "where are we dining?" The question is limited to one specific item / activity for the crew to choose.

Box 7 may seem a poor area for the commander to move to for a decision. Actually if the commander uses the appropriate ***"Questioning,"*** it is in fact the most powerful area to be in. An example of the power of box 7 can be seen in the following War Story:

The author was the aircraft commander of a B747-100 returning from Barbados in the West Indies, on a composite North Atlantic Track to London Heathrow. Three hours out of Barbados, the Aft Cargo Fire Detector warning light came on. The QRH drill was carried out and all but completed, except for the last item which required descent to 24,000ft to assist the fire suppressant in the hold. Before a descent was initiated, the crew had to decide where they were going to divert. If they descended too early whilst in mid-Atlantic, they could find themselves short of fuel. GRADE was the next item to look at and help come to a successful decision.

At the "Analyse Alternative" stage, they came to the conclusion that there were only two options. Barbados, three hours behind them where the weather was CAVOK or Santa Maria, an hour and a quarter ahead of them where the weather was outside limits. The conditions at Santa Maria were, 40 gusting 50 knots across the runway, rain, cloud base less than 100 feet. Bermuda had been eliminated at the "Review" stage since the main runway was dug up and the other runway too short. The first person to speak up was the first officer, who said, "For my money we go to Santa Maria".
The author had also come to the same conclusion, but had not made his views known yet. The moment the first officer said Santa Maria the Flight Engineer leapt down his neck, saying, "No way – look at the weather. I want to go to Barbados." The commander now had dissention on the flight deck. If he over ruled the Flight Engineer he would loose the Flight Engineer's cooperation, which was badly needed.

To defuse the situation and try to get the Flight Engineer onside, the commander decided to use box 7. He asked the Flight Engineer the question "Could you tell me where the Rudder and Elevator cables run?" The flight Engineer went wide-eyed and said "Oh my goodness – let's go to Santa Maria." By using a completely open question, but within the defined limits of the situation, the commander had achieved his objective. This was to get the Flight Engineer to agree, that actually Santa Maria was the best option for them, without having to be dictatorial which would have been the case in days gone by, thus antagonising the Flight Engineer and loosing his co-operation.

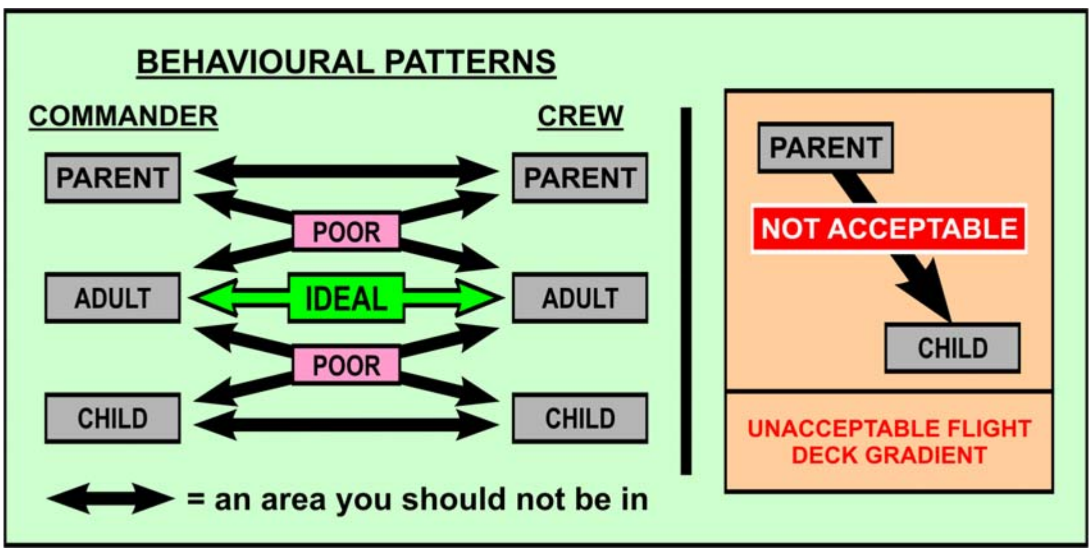
Knowledge of the above Diagram and its boxes, just like GRADE, can be a very useful tool for the aircraft commander. It will help keep the crew together and enhance his Leadership role.

One of the major Leadership roles for an aircraft commander is to keep the passengers onside and happy. This leads us to the use of the Public Address system that will be discussed in section 10.

**SECTION 7 - BEHAVIOUR**

The behaviour of the aircraft commander is very important. If you remember from your CRM, you must always try to remain in "ADULT MODE." This will enable you to achieve the maximum from the crew. Do not go to Parent or Child Mode. If on the other hand someone that you are working with moves away from "ADULT MODE," endeavour to bring them back to "ADULT MODE."

**Remember first impressions last and that *<u>your</u>* BEHAVIOUR breeds the BEHAVIOUR in others**.




Developed from an Eric Berne CTC/Thomson Airline course document Graphic

"ADULT MODE" is what should be the objective response to the current situation.

1. Builds a mental model of others without preconceptions.
2. Honest about one's own feelings and expresses them appropriately, while respecting the feelings of others.
3. Explores the intentions of others, using questioning and listening skills.
4. Considers the consequences of words and actions.
5. Considers not only what they say, but also how they say it.

How do we know that someone is in Adult Mode? - What are the outward signs? Their Vocal signs are that the voice is:

1. Steady and firm.
2. Sincere and clear.
3. At an appropriate volume.
4. At an even pace.

Their physical signs are that the

1. Eye contact is positive but not staring or threatening.
2. Facial expression gives the same message as words.
3. Body language is open and relaxed.

Generally speaking, there are two types of aircraft commander: -

**7.1 THE POOR COMMANDER TENDS TO AGGRESSIVE BEHAVIOUR, WITH THE FOLLOWING TRAITS**

a. Quick to Anger.
b. Little Self Control.
c. Threatening Body Language.
d. Telling.
e. Shouts.
f. Swears much of the time.
g. Gets excited quickly.
h. Focuses on Personalities.
i. Rants and is irrational.
j. Basically under-confident.

**7.2 THE GOOD COMMANDER THAT HAS A POSITIVE ASSERTIVE BEHAVIOUR, IS A LEADER WHO**

a. Is calm.
b. Is controlled.
c. Uses appropriate Body Language.
d. Listens.
e. Uses appropriate Vocal Volume.
f. Is even-paced
h. Is issue-centred.
i. Stays focused, confident and in control.

7.2.1 If both the commander and the crew stay in “ADULT MODE,” they will achieve what is called “EFFECTIVE BEHAVIOUR,” and will

a. Focus on the objective.
b. Listen to each other.
c. Ensure mutual understanding.
d. Talk about the issues concerning the objective – NOT personalities.

7.2.2 If all, of the above are achieved then the result will be “EFFECTIVE ADULT” behaviour.

a. The matter will be settled.
b. There will be a mutually acceptable outcome.

**SECTION 8 - FEEDBACK**

As an aircraft commander, you must learn how to give *“feedback”* as well as receive *“feedback.”* This is a form of effective behaviour that you must acquire. If you are to become a good commander, one of your duties is to develop the potential in the first officers that fly with you. For example, a new first officer just joining the company needs to be introduced to the “Ways” of the company. You will tell the first officer how things are done differently in your company from what they have just produced, in order that they can become an integral part of the standard company. The new first officer may be very experienced and have come from another airline or the Royal Air Force, where in both cases things are done totally differently. Despite the fact that they may be experienced from another source, they have to adhere to the company SOPs. So what exactly is the definition of *“feedback?”*

*“Feedback is a communication between two or more people where the intention is to change the way something is done, in order to improve the performance of a person or group. It is not a criticism. The intention is to improve standards.”*

This Communication reinforces effective performance as well as producing change; it is also a two way communication. Let us take an example of this. You as commander gave away the sector to your first officer. The flight was handled very well except for the approach, where the first officer was pumping the thrust levers on the ILS.

After landing and at a **suitable moment,** you explain to the first officer that it is important to know datum power settings and of the need for gentler movement of the thrust levers, which combine to give a stable approach. Notice that for the *suitable moment* to be effective, you must choose the correct time and place to offer this explanation: -

1. While the memory of the incident is still fresh.
2. While the person is not busy with other tasks.
3. Privately, not in front of other staff.
4. Make it friendly and comfortable.
5. Do not be critical. You are assisting in the development of an individual.

When giving feedback always make it positive. Do not be negative or you will not achieve your intended objective, as the person will clam up and discard your information. Another useful point to remember is to have some “Good Point” up your sleeve to finish with. Having given your feedback to the first officer about pumping the thrust levers, tell him that you much appreciated the very good and precise briefing that was given just before the top of descent. You want to leave the person feeling good, because in that way: -

1. They will respect you.
2. They will take on board your feedback.
3. They will improve, and
4. *You* will have achieved your objective … Well done.

Remember also that feedback is a two-way communication. Let us say that you have been the handling pilot on the approach and landing. You feel that it has been a bit rushed but safe from the point where you passed flight level 100. This is the time to receive feedback. The first officer might be sitting on the vital clue that you have missed but is frightened to tell you. Have the guts to open up with a friendly open question. Say to the first officer “Was there anything that we could have done better on that approach?” Now it is the time for you to listen: -

1. Listen to what is said.
2. Check that you understand what is being said.
3. Encourage the discussion.
4. DO NOT be defensive.
5. Be open.
6. You will learn something.
7. Acknowledge the first officer’s effort.
8. Say thank you at the end of the discussion. The pair of you will have achieved a vast amount, and both of you will be safer and the better for it.

It is most important when giving or receiving feedback that your behaviour remains in “Adult Mode.” If you do not remain in adult mode, you will have lost everything including the respect that people will have for you.

There will be the odd occasion where you will have to exert your authority. This is when there has been a gross or deliberate excursion from the norm. This is when a “Disciplinary” action or style is needed. That is, the “TELLING” style has to be used, not discussing. One of two things will occur: -

1. The individual or group will accept “The Telling Off.” If good reasons are given, the “Case” will be closed. If so, then there is the opportunity to help the individual or group to recover.
2. If the case is not closed, then perhaps the next step is a visit to a higher authority.

## SECTION 9 - HELPING OTHERS

Helping others leads on naturally from feedback. What is feedback other than giving assistance? However ‘Macho’ we are, all of us need help at times. Yes, that means aircraft commanders as well. One useful tip is to develop a “Buddy System” where you can go and talk to a good friend in the company and discuss your problems. He/they can also discuss their problems with you. This is particularly useful when you become a training captain. This position can be very lonely. However rewarding being involved with training may be, it is very comforting to find a way to get feedback about your performance, which you are then able to improve. It is also useful to get your buddy’s perspective on a problem that may be worrying you.

When offering help you need to prepare yourself for the situation, which sometimes can be very difficult for those you are talking to, particularly if you are imparting bad news. To achieve this, you need to do the following:

1. Set the scene for a friendly discussion.
2. Reassure them.
3. Encourage them to talk.
4. Listen attentively.
5. Show concern and understanding for the predicament that they are in.

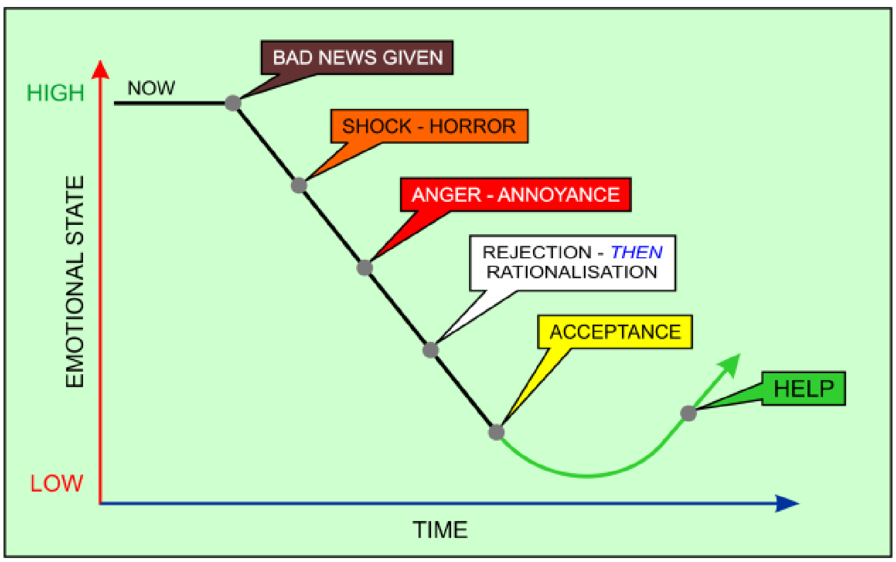
6. Help them think-through the situation.
7. Admit that you too have difficulties – thus increasing bonding.
8. Do not express your views.
9. Get them to acquire facts and options for themselves.
10. Let them find their solution to the problem by talking it through.
11. Set up an action plan with them.
12. Suggest another meeting to check progress.
13. Be supportive at all times

## 9.1 THE S.A.R.A.H. PRINCIPLE

You will find that the person you are communicating with will live through a crisis and undergo a series of events collectively known as the S.A.R.A.H. principle. He/They must be worked through the complete cycle to achieve recovery.

**S** = **Shock** & Horror on receipt of the news.
**A** = **Anger** & **Annoyance** at getting the news.
**R** = The feeling of **Rejection** initially, which turns to rationalisation. “OK I have failed.”
**A** = **Acceptance** that there is a problem and that they want to rectify it.
**H** = The desire and need for **Help**.

The diagram that follows illustrates **THE S.A.R.A.H. PRINCIPLE**




**Re-crafted CTC course document**
**(from Amoco’s Bill Clover description of the principle)**

## SECTION 10 - PUBLIC ADDRESS

The Public Address system, better known to Flight Crews as the PA, is one of the most neglected tools at an aircraft commander’s disposal. It is frequently considered an unnecessary nuisance. “Oh dear, I suppose that I ought to speak to the Punters”. This is an attitude which comes across Loud and Clear, when the speaker does get onto the PA. The passengers feel cheated and let down by someone that they want to respect. They have paid good money to travel with this airline and privately they are saying to themselves “What is the safety like on this airline, if the speaker who is my pilot, is so bored and casual?” Remember that first impressions are very important. The PA is an enormously powerful weapon; it does not just concern the Flight or Cabin Crew who use it. It portrays the whole attitude of the airline that you work for, by **What is Said** and the way **<u>You</u> say it.**

Hopefully, these few tips will encourage you to produce better and far more enjoyable PAs and will enhance your status and the good name of your company.

Let us therefore look at the times that Flight Crew use the PA:

1. The “Welcome Aboard.”
2. The in flight progress report.
3. The in flight emergency.
4. The “Good Bye.”

### 10.1 THE WELCOME ABOARD

The first PA of any flight should be done by the aircraft captain, regardless of who is the handling Pilot. By all means, hand-over to the first officer who, time permitting, will introduce him or herself on the way out to the runway, if they are the handling pilot.

Introduce yourself with your first name, followed by your surname, and by all means use the title Captain if that is what is normal in the airline that you work for. Do not say, “This is the Captain speaking”. How often does one hear this, and the word “The” gets swallowed and the passengers hear “This is Captain Speaking”. Captain Speaking must have been a very busy man and fathered a huge family, as there are at least ten ‘Captain Speakings’ in every airline. Make the passengers feel genuinely welcome; you want them relaxed. They have had hassle and trauma getting checked in and then progressing through all the multitude of formalities that modern day passengers have to undergo before they arrive on your aircraft. If you can make them relax, your Cabin Crew will have a much easier time and there will be less chance of passenger rage, which makes for a very difficult day for everyone concerned. Keep the introduction **short** and to the point. Tell the passengers that you will be speaking to them again during the flight so that they do not feel “Is that all we get?” Most important of all is to get feedback from the Cabin Crew on the welcome aboard address: Was it clear? Was it loud enough? Was it heard through out the aircraft?

The golden rule about the PA is to know your facts before you speak, so ideally rehearse it before you go “on Air.” If you have a delay, find out from the ground staff the **real** reason for the delay, if you are just taking over the aircraft and what the passengers have been told so far. If something goes wrong after you have taken over the aircraft, such as engineering or ATC. Do not try to pass the buck or to blame another individual or group, for example ATC. Remember that one of those groups’ colleagues may be travelling as one of your passengers. This will cause trouble, not least an angry letter to the company. You could find yourself in the Flight Manager’s office as a result. This will also antagonise ATC against your airline in the future.

### 10.2 A DELAY

If you have a creeping delay, always tell the passengers that you will update them on the progress. Give a time interval, such as “I hope to have more information when I speak to you in twenty minutes”. Don’t ever say “I will get back to you…” You are not going into the cabin to make the announcement. Make sure that you speak to them just before the twenty minutes is up, because sure enough some of the passengers will time you. A late PA will cause aggravation. Even if there is no further information in twenty minutes time, still speak to the passengers. It shows them that you are concerned for their welfare. Get feedback from the Cabin Crew as to what the mood is like in the Cabin. If the mood is becoming nasty, show yourself in the cabin, this is the one time that you do go back. If needs be, make an announcement standing in the cabin where the passengers can actually see you – yes, it takes guts, but is much appreciated and makes a powerful statement. Remember that the passengers in a creeping delay are cooped-up and boredom breeds discontent. If this is left unchecked, you will have a major problem in the cabin, with the passengers abusing the Cabin Crew. Your company policy may include some additional cabin service and knowledge of what is being provided and how long this might take can provide additional time management tasks, especially on the largest aircraft.

One way of avoiding potential ‘Air Rage’ is to divert the passengers’ attention. A suggestion: have a teasing question up your sleeve. Pose the question to the passengers and tell them that there will be a prize for the first correct answer, for example, a bottle of Champagne or what ever else you can commandeer from the aircraft bar. The author has on several occasions used this technique very successfully and asked the question “Name the most Northerly, Southerly, Easterly and Westerly states of the United States. Tell them to write their answer on a piece of paper and hand it to the Cabin Crew, who will bring it to the flight deck. By handing the answer to the Cabin Crew, the passengers are now communicating with the Cabin Crew in a friendly and positive manner. Should the correct answer arrive too early, put it to one side and keep hectoring the passengers that some of the answers are very close. The occasional use of the PA to urge the passengers on works wonders, the Cabin Crew will have an easy time since the passengers will now be preoccupied with the quiz and your delay will go more smoothly and any potential trouble will have been defused. The answer to the above question is: - The most Northerly state is Alaska, most Easterly is Alaska and most Westerly is Alaska. The 180° meridian goes through the Aleutian Islands which are all part of the state of Alaska; this is where East meets West. The most Southerly state is Hawaii.

### 10.3 THE IN-FLIGHT PROGRESS REPORT

During the flight, make another PA, since you have already told the passengers that you are going to be updating them on the progress of the flight. What therefore are you going to say? The answer to this question lies in the type of passenger that is most predominant on the aircraft. Are they mostly “Business” passengers, or “passengers going on holiday?” Decide what type of flight you are operating and review the style that you are going to use.

#### 10.3.1 Business Passengers

This type of passenger wants minimum interruption. There are flights that are almost totally business, for example Luton to Barcelona. These passengers have a totally different requirement from the PA than holiday makers do and would like; whereas the passengers who travel from Luton to Malaga are virtually all holidaymakers. So decide on the passenger group that you have and then prepare your PA accordingly.

Business people want to know: -

1. The time of arrival; and

2. What the actual time is now at the destination, so that they can set their watch. “You need to move your watch forwards or backwards “X" hours.”
3. What the weather is likely to be on arrival.
4. A quick top of descent PA with any short update as is necessary. Give the very latest information on the weather conditions.
5. If you are ahead of schedule, give an ‘on schedule’ arrival time, it has an excellent psychological effect, when they hear you tell the Cabin Crew “Ten minutes to Landing”. They suddenly realise that they are landing early, which in their eyes is a bonus.
6. They are not interested in the route or anything else. They want to get on with their work and wish that you would stop interrupting, with what in their eyes is totally irrelevant information, causing a nuisance factor. They have flown this sector dozens of times and they want to get the flight over with as soon as is possible.

10.3.2 The Holidaymaker

Holidaymakers on the other hand have paid, what in their eyes is quite a large amount of money, and expect something in return. The flight after all is the beginning of their holiday; they are excited and want to know everything. They need much more information than the business person does.

The holidaymaker wants to know: -

1. How high you are flying.
2. What is the speed?
3. What the route weather is likely to be.
4. Where they are now.
5. What the routing is.
6. Prominent features that they can see en-route, such as towns, mountains, rivers or islands.
7. The time of arrival.
8. The time now at their destination.
9. How much longer to go.
10. The weather and most importantly the temperature at their destination.
11. Further PA announcements if there are major points of interest to be seen.
12. A top of descent PA to let them have the very latest information on the weather conditions.
13. Which way you will be making the approach and to which runway.

One major item to remember is not to emphasise bad weather that may occur both during the flight and at the destination, it frightens passengers of both categories. Remember that business passengers are already under stress, since they are worried as to whether they are going achieve their objective on their mission and satisfy their boss. Both groups of passengers can become worried to the point of hysteria. The least said about poor weather conditions the better, play it down to the point of not mentioning it, if possible. Remember though that you are responsible for their safety. So make sure to have them “Belted-in” before you encounter turbulence.

**10.4 THE IN- FLIGHT EMERGENCY**

This is the time that the PA really plays an important part.

10.4.1 Unpremeditated Emergency

It is a quick and easy way of warning passengers or of crowd control should the occasion arise. You have to think fast and use it so as not to make the situation worse and cause a total panic. Steer them away from the danger.

10.4.2 Premeditated Emergency

When an in flight emergency arises, if possible do not inform the passengers until you really have to. You may be lucky and not have to tell them anything at all, especially if you are continuing to your destination and their safety is not in jeopardy. For example if an engine is shut down during cruise, do the passengers really need to know? They will not know the difference between a two engine landing and a single engine landing. If on the other hand there has been an audible bang or some other non-normal characteristic, then you must tell the passengers in order to allay their fears. Downplay the problem and let them know your intentions, i.e. Diverting to… because … If you still have some way to go to your landing airfield and you feel it necessary to tell the passengers prior to landing because it involves their safety, try to delay it as long as is possible, that is if they have not felt or heard anything unusual. If you inform the passengers immediately they will have time to think about it and panic will start.

By delaying the PA announcement, not only will you delay the onset of any panic, you also give yourself time to decide what needs to be said and practice it so that it comes across in a confident organised manner giving the passengers the reassurance that they will need. They want to follow you, so be confident and reassuring and they will do exactly as you say. If you need them to do an evacuation on landing or something similar, they will need to be thoroughly briefed.

As a suggestion, when you have to tell them what they need to do, start with the phrase “I need your help” then explain to them why. You will be surprised at how they will respond and rise to the occasion and thus reduce panic. You can then leave the detail of the brief to the Cabin Crew; the passengers will now be much more cooperative and attentive. You will save lives this way.

Now try to explain this ‘peeled’ engine cowling in a way that will not cause panic in the passenger group …

PD Photo from theCHIVE.com

## 10.5 THE GOOD BYE

The “Good Bye” is equally important if not more so, since the last thing that is said sticks in peoples’ minds. Your company wants all your passengers to come back and hopefully bring a friend as well, because you made it such an enjoyable journey. If they do this then not only will you be achieving your objective of being a good aircraft commander, but also you will be enhancing your company’s image and profits.

Let us look at a few simple rules when saying good-bye.

10.5.1 Liaise with the Senior Cabin Crew member as to who is going to say “Good-Bye”, but **not** both of you. When both of you say good-bye, it is very tedious for the passengers and all the previous good work that has been done during the flight on behalf of your company is destroyed, by **“PA Overload”.**

10.5.2 If it is a very short taxi to the ramp or a very congested area for taxiing, let the Cabin Crew say good-bye on behalf of **“THE COMPANY”.** Too many airlines today have “In-fighting” between the Flight Crew and the Cabin Crew as to who has been in charge. Remember that it is a team effort on behalf of **The Company.** The passengers will pick up this “Infighting” very quickly and their whole image of the flight Crew, the Cabin Crew and The Company falls drastically.

10.5.3 If it is decided that you are going to say good-bye on behalf of The Company, hand the aircraft over to the First Officer to do the taxiing and R/T, while you concentrate on the **Short PA**. Again, it is so obvious when the Captain is trying to speak and taxi the aircraft. Would you have a meaningful conversation with someone, when you were not giving them your total and undivided attention? You know very well what their reaction would be. So why do it on one of your more important PA broadcasts?

## 10.6 SUMMARISING

The PA, therefore, if used properly, can be the most wonderful as well as powerful tool at your disposal. Before you use it: -

1. Always remember to whom you are speaking.
2. How important they are.
3. It is **Your Company** that you are representing.
4. Know your facts.
5. Think carefully.
6. Organise what you want to say.
7. Mentally practice it, to eliminate “ahs and ums.”
8. Then **Say it** with meaning and sincerity.

**SECTION 11 - WORKING WITH FMS – Sometimes a route into trouble**
by Captain Robert A.C. (Bob) Scott, FRAeS

**NEAR-ACCIDENT SYNOPSIS**

*"The aircraft was carrying out a routine scheduled passenger flight between a London Airport and one in Ireland. The major part of the flight was operationally uneventful until the approach phase to the Irish airport was commenced. Here, some confusion arose with the cockpit crew as to the Runway (RWY) in use for landing. They had initially flight planned for RWY 09 but Air Traffic Control (ATC) advised that their requested Non Directional Beacon (NDB) approach to RWY 09 was unavailable and cleared them for an Instrument Landing System (ILS) approach to RWY 27, from which they could carry out a Circling Approach to RWY 09. This ATC information led to an ILS approach to RWY 27 with the aircraft incorrectly configured. The approach was abandoned at about 400 feet above ground level (AGL), as the crew became visual with RWY 27, and a go-around was carried out. About this time, also, the Enhanced Ground Proximity Warning System (EGPWS) sounded".*

FINAL REPORT EXTRACT

*"The Captain and First Officer were so engrossed in trying to reprogramme the FMC that they both lost their critical situational awareness for a time. Contributing to this was their relatively low time and knowledge of the electronically sophisticated B737-800, as opposed to the older generation electro-mechanical B737-200 aircraft, on which both pilots were most experienced. This cognitive deficit led to their difficulties in managing and interacting with the B737-800 automation.*

*"This Serious Incident is defined in ICAO Annex 13 as Controlled Flight Into Terrain (CFIT) only marginally avoided".*

*CAUSE*

*"This serious incident was precipitated by both pilots becoming involved in manually programming the FMC with the temporary waypoint during descent, thus diverting their attention from safety-critical tasks contrary to the Operator's SOP and leading to a non-briefed and non-configured high speed approach to Runway 27, followed by a non-procedural go-around".*

There is no simple answer to this other than there must never be a time when both pilots are heads down, except when the aircraft is 'chocked' on the stand. It is a well-known fact that the early days of using an FMS are the ones most likely to produce the sort of situations that have prevailed in many accidents and near–accidents. Yet we continue to put crews through abbreviated training courses that, of (commercial) necessity, deal mainly with 'normal situations, rather than 'abnormal' ones.

In this recent near-accident, the PF had successfully completed a simulator check ride on the previous day, and it would be interesting to know the contents of that check-ride. Things may have gone totally according to plan during the simulator check, with the result that his actions and expectations on the flight in question may have been conditioned through that training / checking experience. Hence, when confronted with a different runway to the one both he and his First Officer had expected since briefing for the flight in Operations, the result was confusion, incorrect programming of the FMS, lack of effective communications between the two pilots, and, very nearly, the loss of an aircraft and all on board.

While there is nothing inherently difficult about late runway changes, etc, when using an FMS, the occasional lack of logic and the number of procedures that have to be carried out can often be overwhelming to the novice crew and a distraction at critical phases of flight, which is when such changes are usually demanded. I spent many years converting crews on to 'glass cockpit' aircraft, and emphasising to them the necessity of keeping things simple, especially in the early days. The need to make correct and error-free FMC entries, with measured deliberation, has never changed.

Operating Procedures must be absolutely clear on these points:

1. When reprogramming the FMS computer, one crewmember must always be 'heads-up', looking after the aircraft.
2. For departures / arrivals the FMS should normally be programmed by the Pilot Flying (PF). Prior to this, the PF will hand over control of the aircraft to the Pilot Not Flying (PNF) also known as Pilot Monitoring (PM), a term adopted by Boeing. When the PF has completed the programming, he / she will take-back control of the aircraft and the PNF (PM) will check the route, etc., in the FMS. The departure / arrival briefings should make reference to what has been loaded in the FMS, to ensure that it relates to what is expected to be flown.

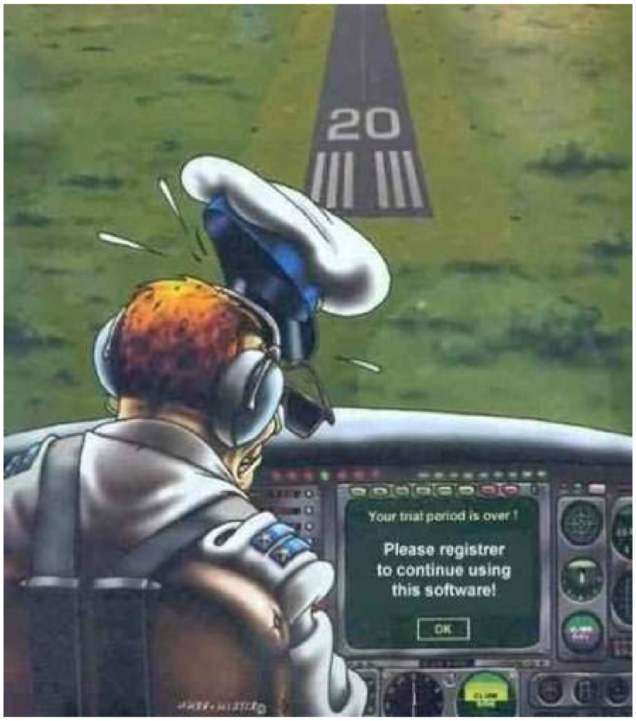
Other guidance on use of the FMS will deal with climb, descent and en-route procedures, emphasising the necessity for avoiding a situation where both crewmembers are 'heads-down'.

Training must emphasise the importance of *'getting back to basics'* when necessary. I often got my trainees to fly a climb or descent in 'Flight Level Change' (FLCH on the B747-400), instead of VNAV; using DME and whatever else was available to gauge the climb / descent profile. Some of the results were interesting but it always got the message across; that the FMS in only a tool and that the PF actually runs the show.

There is a place that lies somewhere between professionalism and egotism that often prevents a pilot admitting that he /she has not got a clue about what ATC have demanded of them, and asking for vectors, or whatever may be required to expedite the proceedings. Often pilots seem to think that the answer must be buried somewhere in the FMC and persist with digging for the information, instead of taking the easier and, often, much safer option by asking for help

The answer is, and always has been, better training. The training should include emphasising that when things start to get out of hand and the solution is not apparent, '***get back to basics, and use all resources available***', including swallowing one's pride and asking ATC for assistance if necessary.

Although the industry has an enviable safety record by any standards, CFIT remains stubbornly resistant to improvement. When both pilots are heads-down at critical phases of flight, and neither is looking after the aircraft, safety margins are seriously eroded and the chances of another CFIT accident increase.




www.crazy-jokes.com

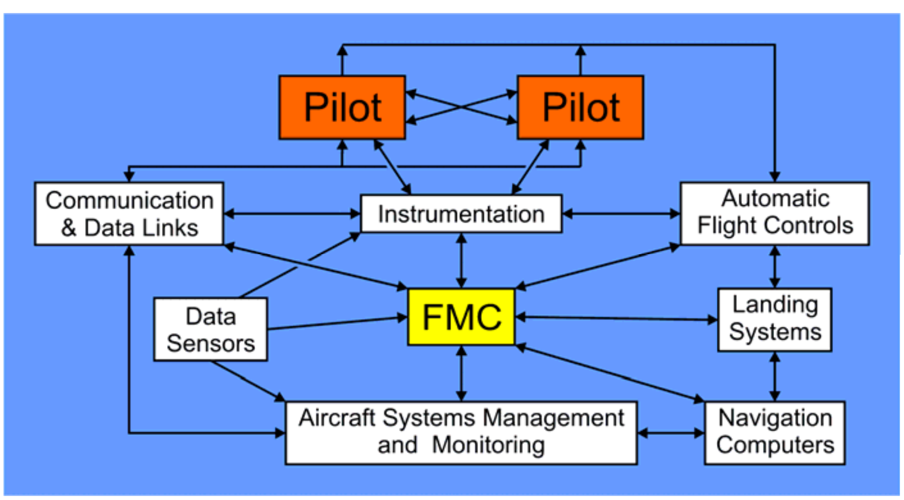
It is right that this near-accident has been taken seriously, as it so nearly resulted in yet another CFIT statistic. It seems to me that it varies only in detail to the Eastern Airlines L1011 accident in Florida, the Flying Tiger 747F one in Kuala Lumpur, and all the (many) others that have followed. They all have a common theme: the crew lost their situational awareness due to being distracted by a combination of technology with a conflicting mental model of their situation and poor cockpit discipline.

It does not matter how smart we design our aircraft to be, I regret to say that we will never be rid of this problem unless we provide the highest level of training at the initial conversion stage, then reinforce it through periodic training and checks. Too often, licence renewal simulator (or aircraft) rides are nothing more than a box-ticking exercise that satisfies regulatory requirements but does nothing to enhance the knowledge or skill level of the pilot. Commercial expediency exercised by management to reduce training costs is one side of the equation: the other is, regrettably, sometimes a less than disciplined performance by the crew.

Both sides must acknowledge their responsibilities in keeping accident statistics to the lowest level possible.

## SECTION 12 - AUTOMATION MANAGEMENT

### THE COMPLEX MODERN FLIGHT DECK




Graphic by Captain Philip H S Smith MRAeS

Automation is nothing new to aviation. In the 1930s, the 3-axis autopilot was developed. Since then, there has been a great advance in what is now called "Auto-flight." But the modern auto-flight system is very complex with different units talking to one another. Like all good tools it is only as good as the operator who gives the correct commands at the appropriate time. There is a tendency to go “Heads Down” and forget the basic task of flying the aeroplane.

Remember the Eastern Airlines Flight, where the aircraft flew into the ground in the Everglades; because the whole flight deck crew had gone heads down and no one was monitoring the flight's progress. Auto-pilots need monitoring at all times because they only do what they are programmed to do.
If the expression "What is it doing now" is heard on the flight deck, it means that the crew member has not acquired sufficient technical knowledge of the system. Thus an inexcusable error occurs, that either reflects insufficient training and/or demonstrates an inability to assimilate information by the pilot(s).

### 12.1 Factors contributing to Automation Accidents

1. Mode confusion ……………………………………………………………
2. Insufficient knowledge of the capabilities and limitations of the system. .
3. Unwillingness to take manual control.
4. Design and certification mismatches.
5. Inconsistent systems behaviour.
6. Failure to follow Standard Procedures. ……………………………………
7. Lack of correct monitoring.
8. Taking control too soon, through lack of confidence in the system.
9. A lackadaisical attitude by the operator.

Source FAA Report 1996

### 12.2 Factors That Assist In Safe Operation

1. Learn the capabilities and limitations of each automatic flight mode.
2. Only use automation in accordance with company S.O.Ps.
3. Announce and confirm every automatic flight mode selection.
4. Remain in the loop by actively monitoring the flight instruments.
5. If the automation is causing confusion, consider flying manually.
6. Use your superior judgement and experience to manage the flight and the automation.
7. Possess an expectation of the outcome for each mode/switch/ option selection.

Doug Schwartz of Flight Safety International stated that "Pilots need to be taught that the automation is there only to support the crew, and that the safe, efficient operation of the aircraft still remains their sole responsibility."

## SECTION 13 - CONTROLLED FLIGHT INTO TERRAIN (CFIT)

### 13.1 CFIT PREAMBLE

CFIT is a term developed by Boeing in the late 1970s and is pronounced *CEE-FIT*. It describes an accident whereby an airworthy aircraft, under complete control of the pilot(s), inadvertently flies into terrain (or an obstacle, or water), usually with no prior awareness by the crew. Some CFIT accidents have been the result of equipment malfunction.

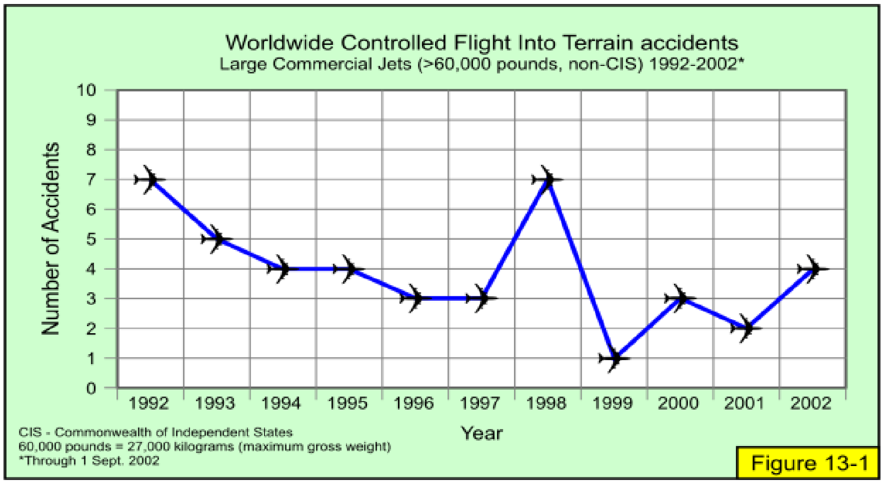
The pilots are generally unaware of the danger until it is too late. In civil and especially private aviation, CFIT may be humorously referred to as **rock-filled cloud** or ***'Cumulogranite'*** when it is caused by terrain being obscured by clouds. CFIT incidents have the following characteristics:

a. They can occur with pilots at all levels of experience, even highly experienced professionals.
b. Usually involve impact with significantly raised terrain such as hills or mountains.
c. In some accidents have involved fatigue or disorientation.
d. They usually occur near an airport.
e. They often occur in conditions of cloud or reduced visibility.

The Flight Safety Foundation (FSF) is leading landmark efforts to prevent the two major causes of commercial-aviation fatalities: controlled flight into terrain (CFIT) and approach-and-landing accidents (ALAs). The Foundation in the early 1990s mounted a major attack on these two killers, which together accounted for **80 percent** of fatalities in commercial transport-aircraft accidents from 1979 through 1991.

This type of accident can occur during most phases of flight, but CFIT is more common during the approach-and-landing phase. By definition, this begins when an airworthy aircraft under the control of the flight crew descends below 5,000 feet above ground level (AGL) with the intention to conduct an approach and ends when the landing is complete, or the flight crew flies the aircraft above 5,000 feet AGL en route to another airport. Descent for an approach should only commence from some known 'Fix', so that 'Gates' or 'Waypoints' can be constructed for distance against altitude checks, if only mentally (see 14.1), to maintain a continuous stabilized 3º approach path. It is also vital to remain constantly aware of the MSA so as to never descend below it without knowing exactly where you are.

The FSF-led international CFIT Task Force, created in 1992, set as its five-year goal a 50 percent reduction in CFIT accidents. Among large commercial jet airplanes, seven CFIT accidents occurred in 1992; five CFIT accidents occurred in 1993; four CFIT accidents occurred in both 1994 and 1995; three CFIT accidents occurred in 1996 and 1997; seven CFIT accidents occurred in 1998; one CFIT accident occurred in 1999; three occurred in 2000; two occurred in 2001; and four occurred in 2002 (data up to 1 September 2002).




**Data source: Boeing** Graphic by Captain Philip H S Smith MRAeS

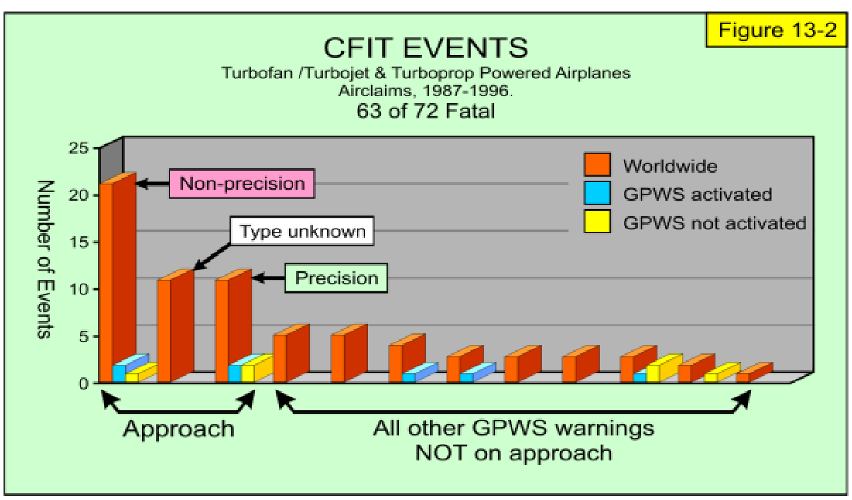
The CFIT task force included more than 150 representatives from airlines, equipment and aircraft manufacturers, and many other technical, research and professional organizations. The task force believed that education and training are readily available tools to help prevent CFIT accidents.

### 13.2 CFIT CONSIDERATIONS WHEN ON INSTRUMENT LET-DOWNS

Further studies into CFIT revealed that most of the CFIT accidents occurred during Non-precision Approaches (See table below). Why? Probably because Non-Precision Approach have poor horizontal guidance and no approach slope indication for assistance, thus causing confusion and loss of spatial awareness. Pilots are not generally happy when flying Non-Precision Approaches because of the added stress of having to fly such approaches very precisely, to achieve the necessary track and vertical profile to a successful landing. It is most important for crews to be aware of the lateral and vertical situation of the aircraft at all times after commencing descent from cruise altitude, all the way to the runway. (See Figure 13-2)

A clear and precise briefing is essential and always assume that you are going to have to do a full instrument let down at your destination. If on arrival the weather is VFR, you are prepared at least for the worst, and have been given a bonus. Once descent is commenced, check your altimeters, make standard call-outs and cross-checks and make sure that all the ‘raw’ data has been set correctly.

If at any time during an approach you should be unfortunate enough to get a GPWS warning, react to it immediately. Do not try to analyse it. Remember above all, that once you are in the approach segment and below MSA, you are in the “Valley of Death.” Know your position in relation to high ground and if disorientation occurs ***“Hit the TOGAs”*** and climb out of the Valley of Death as quickly as possible. Do not try to continue the approach while trying to re-orientate yourself. It is asking for trouble. Most importantly know your GPWS drills.




**Data Source Boeing** Graphic by Captain Philip H S Smith MRAeS

## 13.3 AVOIDING OVER-RUNS ON LANDING - ANOTHER FORM OF CFIT

Training Implications of Aircraft Accidents on Approaches to Land
by Captain Ralph Kohn, FRAeS

**Pride and Ego - A Lethal Combination**

There is no place for ego trips on aircraft flight decks. The strong urge to land at all costs at the nominated destination must be closely controlled. It takes a lot of discipline, guts, moral courage and a large amount of personal humility to recognise that bruised pride must be set aside, after a bout of poor handling during the approach has created a potential emergency. If the approach flown 'turns to worms', it must be discontinued. "Get away from trouble" is the message, regardless of the fact that crew cars are parked just round the corner. Push the throttles wide open as the nose is rotated upwards to the target nose-up angle and carry out a missed approach. Loss of face?... What loss of face…? It is no more than just good and sensible airmanship. Having honestly admitted that on this occasion the aircraft is in no position to land safely, there is only one safe alternative. … Blow pride and do what must be done … fly another approach or divert.

It is also a very good idea to limit the number of attempts to land at the intended airport after a first missed approach. Sensibly, two approaches should be enough before diverting to an alternate with a less problematic weather situation; providing there is sufficient surplus fuel on board for the second approach or it will turn the whole day into a totally ruined one, by having to declare a fuel emergency as well. Occasionally, a third approach may be considered but use this option sparingly, especially when tired.

It was possibly pride, allied with a reluctance to speak-out, that destroyed another perfectly good aircraft, witness far too many similar and totally avoidable runway overrun events over past years.

The A-340 seems to have crossed the threshold at 100 feet. That is 50 feet higher than normal and slightly above the glide-slope; at a speed that suddenly increased to 154 knots from the correct 140 knots approach speed for the 185 tonnes aircraft weight. The autopilot and auto-thrust were engaged for the approach. Both were disconnected at about 350 feet, after flying through a near-by thunderstorm area. Was this aircraft totally stable below 500 feet? If not, why was a Go-Around not executed then, or even when crossing the threshold, given the situation? It then landed in heavy rain in a tailwind component of some 5 knots as the wind veered at aircraft touch-down, approximately 4000 feet down the very wet 9,000-foot runway; possibly also aquaplaning, only to leave the paved area at the far end at a speed of 79 knots, to finish-up in a wooded, steeply hollowed area. Maximum brakes were applied and thrust reverses were fully deployed by 14 seconds after touchdown, to no avail. They still ran off the paved area!

Regrettably, the co-pilot who was actually flying the aeroplane seemed intent on a full stop landing, once he got above the runway.

CBC News photo

Air France Flight 358 Airbus A340 F-GLZQ crash at Toronto (Pearson) Airport - 2 August 2005

Did a reluctance to admit to a wrong initial decision through ego and/or arrogance play any part in that accident, from which all crew and passengers walked away; even though the aircraft fuselage broke-up in three places and then caught fire? The airport authorities (who had been warned of its dangers over 30 years ago by pilots, after a similar accident, but clearly to no avail), could have easily filled the big hole beyond the runway-overrun area. It is deplorable that the Airport Authority did not even provide a cheap and effective deceleration-strip; a pit full of pebbles (commonly found alongside steep roads as an escape route for trucks with brake failure). Such a deceleration pit would remove, or at least reduce, the risk of ending-up in the trees during any over-run between the upwind threshold of the runway and the big wooded depression. The wrecked aircraft is still there to-day … one of many 'holes' in the *Reason's* 'cheese' analogy, that on that day lined-up to form the tunnel to a long-forecast repeat accident !

As an aside, such deceleration strips should be made obligatory for ALL runways by 'responsible' airport authorities. The authors of this document suggest that ICAO should encourage this, by adopting such strips as a 'Standard'.

Luck was on the survivors' side. It was neither the flight crew with their decision to land, nor the failure of the Airport Authority to provide a really safe over-run area, that saved them that day. Neither the captain nor the air traffic controller apparently queried the intent to land, following what should have been a precision approach from which a manual landing could have occurred. The aircraft was clearly way above the normal precision approach path and half way down the runway before it touched down. Even then, a go-around could have been the correct, safe action and the right decision. What happened to monitoring and Crew Resources Management (CRM) precepts? Why did the captain, who reportedly let the First Officer fly the approach and land the aircraft, seemingly do nothing to initiate a missed approach? What a disastrous break-down in human factor terms for a major Western Airline, regardless of all the new CRM courses that pilots undergo in Europe and hopefully elsewhere, as required by their National Aviation Authority.

It is necessary that those of us who fly aeroplanes have the humility to admit that sometimes we are wrong and need to do something positive to reverse a developing 'situation'. Accept a monitoring pilot's intervention without rancour. If monitoring, speak-out if you do not like what you see, even if you may be thought foolish for so doing. It is better for a pilot to say something and be thought an idiot than end up in a ditch. Be sure of your facts and be firm but diplomatic.

Authority gradients on an aircraft accept that the crew is led by the Captain as the legal commander, with the First Officer/co-pilot as next in line as the second-in-command. On the flight deck, the other pilot's position is subordinate to that of the Captain in what should be a complementary and cross-monitoring role. This was also true when Flight Engineers and Navigators were part of the crew. Could it be at all possible, that a Captain with a passive personality, was faced with a co-pilot exhibiting a dominant and assertive behaviour, with a forceful determination to land and hence the continued approach, despite any dissention from that captain?

Airline CEOs and Training Managers should have the wisdom to encourage the necessary clarity of mind among their pilots, to know when NOT to land. If you think a few missed approaches are expensive in normal operations, try having an accident… It cannot be stated too strongly that there is no place for personal pride and ego in the operation of any aircraft and it is apparent that all too often CRM breaks down in the face of such attitudes. What the industry needs is well-trained **"clear thinking pilots"** who know when to say **NO.** These pilots must be Pro-Active, thinking well ahead and be prepared to make a decision when things are not right and act upon that decision.

**Airbus A340 crash at Toronto (Pearson International) Airport 2 August 2005** Wikimedia Commons PD photo USGOV-FAA

**SECTION 14 - REFRESHER ON VARIOUS PHASES OF A FLIGHT PROFILE**
**(Cruise, Instrument Let-Downs & Approaches)**
by Captain Ralph Kohn, FRAeS

## 14.1 CONTINUOUS DESCENTS FROM CRUISE LEVEL

Planning the optimum profile and most cost-effective descent from cruise level has many advantages, not the least of which is fuel economy. A typical example of a continuous minimum power descent from altitude, leading to an unhurried approach to land is discussed; including bearing in mind variations that may be necessary depending on aircraft type, for flap and landing gear extension. I have used this technique when at night in relatively traffic-free airspaces such as when arriving at Larnaca in Cyprus. It works well and it is very satisfying when you get it absolutely 'right' and apply power only when you lower the gear and extend the last stages of flap as you intercept the ILS glide-slope.

Plan to maintain a 3-degree descent path all the way from cruising level to the runway. Where possible commence descent from Cruise level at a distance from destination that is 3 times the height + 10 miles as a rule of thumb, aiming for a continuous 3-degree descent at flight-idle power settings. Fly the rate of descent you calculate applies for the groundspeed you are achieving and the speeds will take care of themselves. The groundspeed may be obtained from the INS/FMS, or you may do a rough calculation of what it is by looking at the Mach number and multiplying by 600. The rate of descent with the power levers at idle should be constantly monitored and trim adjusted to maintain a rate of descent of half the groundspeed x10. For example, for a groundspeed of 400 knots, ROD should be 2000 feet per minute. Distance to go to destination should also be constantly monitored (and multiplied by 3) then compared to the aircraft's height and the ROD adjusted to regain the desired profile. Distance to go can be established using a DME close to the destination airfield, or the intended landing runway ILS/DME; subject to understanding the small error in distance if the aircraft is not on the approach side of the airfield/runway.

If you run a little high, use the spoilers judiciously to increase the rate of descent without building airspeed. However, if time permits and subject to workload, warn the passengers that you are about to extend a bit of spoiler so that they do not become worried and anxious about the vibration and increased noise which they will experience.

At FL100, the speed will have bled back to 250 knots or less, which is good in ATC terms where speed restrictions are in force. Continuous deceleration will occur during the descent on the way to intercept the ILS glide-slope in due course, as speed continues to bleed back towards flap limiting speeds. Flap can then be extended in stages and power eventually applied, to maintain the target approach speed as the landing gear is dropped and landing flap is selected when the glide slope is intercepted.

At high altitude airfields, allow for the effects of higher TAS. Extra distance will be required for deceleration and the radius of turn will be greater than normal. For example for a 25º bank turn the radius of turn is 6 nm at 180kts TAS and will become 10 n. miles at 220 knots TAS.

Variations necessarily occur, but it is interesting to note the fuel at the top of descent and immediately after landing. Work out the amount used and compare to flight plan and other approaches you have flown. You may be surprised.

## 14.2 TYPES OF APPROACH

A safe unhurried "Stabilised, Continuous approach" should always be carried out prior to every landing, whether on a precision approach, where both longitudinal and angular descent path guidance are given for the pilot to follow all the way to touchdown, or when on non-precision approaches. Beware of the rushed approach. A leisurely stabilised continuous approach is also recommended when on a normal visual approach, or during a circling approach after a "cloud-break procedure" using a radio aid. ILS and MLS are examples of Precision approaches, as are MNP procedures. Dependent upon the weather conditions, precision approaches may be hand-flown or they may need to be carried out automatically to a manual landing or a full autoland on suitably equipped aircraft. But remember, only if the crew is fully trained and authorised to operate auto-approaches and/or landings and the airport is suitably equipped.

Remain aware of the role of Air Traffic Control (ATC) during an aircraft's operations in controlled airspace and in the vicinity of an Airport. ATC is the controlling Authority but it is also there to help. Should there be a need for special approach conditions, say for an automatic approach, ATC may be asked to position the aircraft for a longer final than might be usual. For example, you may need a ten nautical miles final to allow the autopilot computers to settle down in the auto-approach mode, for a manual landing or an autoland. Similarly, in an emergency situation such as after a severe engine failure, a pilot is fully entitled to ask ATC for any help that may be needed. Controllers will assist to the best of their ability, to satisfy requests for special priorities regarding positioning for the approach. Remember that many ATCOs will have received specific training to provide assistance for all kinds of technical emergencies and will understand your work-load demands, to give you more time to respond and comply.

Non-Precision Approaches are often complicated by the way they commence and depend on an NDB and RMI for track guidance to the runway. There may well be other aids on the airfield, or nearby, to establish longitudinal tracking to the threshold, such as an ILS or a VOR/DME. These will assist, but they will not provide vertical profile guidance down to touchdown.

ICAO still permits and therefore some Regulators continue to allow the "Dive and Drive" Non-Precision Approach procedure. No doubt, such permissions are well meant but they are not generally practised in the Western world, due to their inherent danger. Although most airlines wisely prohibit it, a few operators still unwisely allow their pilots to use this form of NPA in some parts of the world. However legal this procedure may be for ICAO and some NAAs, it should not be encouraged by operators of aircraft, big or small. Manoeuvring below circling Height/Altitude is generally not allowed by the majority of European airlines; other then when conducting the final stages of a stabilised approach, when preparing to land and in-line with the runway.

*Approaches that do not have an instrument glide-slope are*

1. **ILS localiser only**
2. **VOR**
3. **ILS back beam**
4. **NDB**

These approaches may be flown with or without DME

5. VDF
6. PAR with no glide-slope information
7. GNSS / GPS-WAAS

**Notes:** The two types of NDB non-precision let-down approach leading to a manual landing are:

a. After passing the Final Approach Fix (FAF), the continuous descent approach to Minimum Descent Altitude (MDA), using DME where available. On reaching MDA, an immediate Go-around must be initiated unless the necessary visual reference is available and the aircraft is in a position from which a safe landing can be carried out. On continuous descent approaches, MDA should be treated as though it was a Decision Altitude (DA).

b. On passing the FAF, the descent to Minimum Descent Altitude (MDA) and then to fly level whilst maintaining track towards the runway, up to the Missed Approach Point (MAPt) where a go-around must be carried out if the runway cannot be seen. This is called "Dive & Drive" and is **NOT** recommended, as it is discredited in knowledgeable Western environments.

### 14.3 APPROACHES AND LET-DOWNS ON INSTRUMENTS

*Visual, Precision and Non-precision approaches are further discussed in Section 23*

#### 14.3.1 The Visual Approach


A340-300 on Short finals, Visual Approach, London Heathrow (LHR) - (Wikimedia Commons PD photo by Adrian Pingstone)

For new commanders, the following procedure may be worth considering, rather than flying more restrictive noise abatement approaches when gear and flaps are lowered at later stages of the approach. Upon reaching the "fly level altitude" or *Platform Altitude* down to say 1,500 feet, as the handling pilot, maintain it to the Final Approach Fix (FAF), then

1. Capture and establish the aircraft on the Localiser / Centre Line.
2. At 2 miles from the descent point or 1½ Dots fly-up on the Glide Slope,, select Gear Down then Intermediate Flaps (e.g.15º).
3. Set the correct Power.
4. Set the correct Attitude, then Pause
5. Trim the Aircraft

6. Check Target Speed is achieved.
7. Call for the landing checklist.
8. At ½ a mile from the descent point or ½ a dot fly-up on the Glide Slope, call for landing flap (at which point the landing checklist will be completed).

Most aircraft balloon slightly at this point so anticipate it … then Pitch the aircraft gently down into the Glide slope.

9. By initiating the pitch into the Glide Slope slightly before the Glide Slope capture, one compensates for the aircraft inertia which wants to continue through the Glide Slope, leaving one high (*Anticipation).*

10. Fly to the runway, using Visual Approach Slope Indicators (VASIs) or Precision Approach Path Indicators (PAPIs), where provided, and land "on the numbers".

14.3.2 A Precision Approach (ILS / MLS & GPS-WAAS)

ICAO Annex 2 defines a Precision approach (PA) procedure as: *An instrument approach procedure using precision lateral and vertical guidance with minima as determined by the category of operation.*

Note: - Lateral and vertical guidance refers to the guidance provided either by:

a. a ground-based navigation aid; or
b. computer-generated navigation data.

It is important to realise that a one dot displacement above or below the glide slope is not equidistant from the 'on-glide-path' indication. In layman's language, the actual height in feet above the glide-path is greater than that below it, for a one dot displacement. In the UK, vertical coverage is provided from $1.35^{o}$ to $5.25^{o}$ above the horizontal for a $3^{o}$ glide-path and $8^{o}$ either side of the localiser centreline, to a distance of 10 miles from the threshold.

An Instrument let down and approach may need to be flown instead of a manual visual approach, depending on the actual weather conditions and published aerodrome operating minima (AOM). When Low visibility Operations (LVO) are in progress, a precision approach will be flown down to the published minimum predicated by the relevant cloud base and visibility. LVO approach definitions and categories are as follows, but note the choice of manual or autoland when on Cat 2 approaches and the need for an Autoland in all Cat 3 operations, defined as follows:

**Low visibility** (as used in the context of requiring formal NAA approval before Low Visibility Operations may be undertaken), is taken to mean landing minima less than Category 1 or take-off with visibility less than 500m (1600 ft) – (¼ Statute mile under FAA rules), subject to certain runway lighting and/or marking provisos.

N.B. Remember that it is essential to check the NOTAMs prior to ALL Low Visibility Approaches,

**Category 1 (Cat 1) ILS operation - (ILSC1):** Means a precision instrument approach for landing with a decision height not lower than 60m (200 ft) and with either a visibility not less than 800m or a runway visual range (RVR) not less than 550m. (According to *ICAO Annex 10 and 14*). **(For a manual or auto-coupled approach).**

**Category 2 (Cat 2) ILS operation - (ILSC2):** Means a precision instrument approach for landing with a decision height lower than 60m (200 ft), but not lower than 30m (100 ft) and a runway visual range (RVR) not less than 350m - **(Auto-approach for a manual or auto-land).**

**Category 3a (Cat 3a) ILS operation - (ILSC3):** Means a precision instrument approach for landing with : a decision height lower than 30m (100 ft), or without decision height and a runway visual range not less than 200m - **(Auto-approach to auto-land).**

**Category 3b (Cat 3b) ILS operation - (ILSC3):** Means a precision instrument approach and landing with a decision height lower than 15m (50 ft), or no decision height and a runway visual range less than 200m but not less than 50m. - **(Auto-approach to auto-land).**

**Category 3c (Cat 3c) ILS operation - (ILSC3):** Means a precision instrument approach with no DH and no RVR limitations - **(Auto-approach to auto-land).**

***Note -*** *Where decision height (DH) and runway visual range (RVR) fall into different categories of operation, the instrument approach and landing operation is to be conducted in accordance with the requirements of the most demanding category (e.g. an operation with a DH in the range of Cat 3a but with an RVR in the range of Cat 3b would be considered a Cat 3b operation. Similarly, an operation with a DH in the range of Cat 2 but with an RVR in the range of Cat 1 would be considered a Cat 2 operation).*

During Low visibility conditions when LVO are in progress there is also a restriction on take-off. A **Low visibility take-off (LVTO)** is a take-off on a runway where visibility is less than 400m.

**(See Appendix E for full details of LVO requirements and AOM calculations)**

14.3.3 The Continuous Descent Non-Precision Approach

All aircraft should fly a non-precision approach such as an NDB approach in the same way as an ILS. A continuous 3º descent should be planned, by flying the appropriate rate of descent as mentioned previously (1/2 the Ground Speed x 10, or 5 x the Ground Speed).

Non-precision approaches need to be planned ahead and flown very precisely, to follow a predetermined descent path from the FAF to the runway threshold. A suitable Height against Time profile 'clock' planning procedure is offered at 2.7 in Appendix 12. Either time or distances versus height may be used on the clock. Each pilot will prepare a free hand drawing of the 'clock' and have it clearly visible during the approach, for instant reference. Where DME is available when using this recommended procedure, the non-handling pilot will call out the distance and target height thus :

a. "At 8 miles you should be at 2,400 feet"
b. "8 miles, 100 ft high … (Pause)' … at 7 miles you should be at 2,100 feet," etc.

If there is no DME, call the target height at each 15 seconds (as per figure 23-F in Section 23) thus :

a. "At +15 seconds you are 100 feet high. Be at 1,100 feet at +30 seconds".
b "At + 30 seconds you are 50 feet high. Be at 900 feet at +45 seconds", etc.
c. Continue calls all the way to ***touchdown***, particularly at night and when the MDH/A is high.

*The non-handling pilot needs to make the calls in a crisp manner and then **stay quiet,** so that the handling pilot can think and adjust the flight path accordingly*

It is important to monitor continuously the let-down facility beacon identification 'Morse' group during the approach, in case of failure which may cause the RMI needle to 'freeze' and may not be noticed. Remember that RMI needles can sometimes also point towards Cumulo-Nimbus (Cb) clouds in nearby thunderstorm areas, due to electric interference generated by lightning.

**See Section 23 for further guidance**

14.3.4 The Non-precision 'Stepped' Approach

Stepped Approaches need to be flown particularly carefully and constant cross-monitoring from all on the flight deck is of vital importance. Even more so in this case, make sure that the let-down plate is correctly read and interpreted. It is vital to remain constantly aware of what step level the aircraft is on during the 'stepped' descent so as not fly to an incorrect height because the position of the aircraft is misinterpreted.

In 1992, the crew of an A300B4 jet transport, flying the multi-step let-down approach to Kathmandu, descended one level too far whilst in cloud, thinking the aircraft was one step higher and further back than it actually was on the *'Sierra' stepped approach'* to Kathmandu runway 02. It crashed into the mountain between 16 DME where the procedure starts and the VOR/DME which is located 0.6 nm short of the runway. After 16 DME, the next approach fixes South of 'Fan Marker Hill' were 13 DME (at 10,500 feet), 10 DME (at 9,500 feet) and 8 DME (at 8,200 feet). A few seconds after reporting 10 DME, the aircraft was descending through 8,200 feet (the altitude for 8 DME!). The Airbus hit the steep cloud-covered hillside at approximately 7,300 feet amsl at 9.16 DME, killing all on board.

Where a 'Stepped Approach' procedure is published and it is necessary to fly it down to a runway, a continuous descent approach procedure *must not* be used after passing the FAF because of its inherent dangers. To explain, if one superimposes a continuous 3 degree slope from the FAF to the threshold, it will impinge upon one or more of the steps on the way down, so eroding terrain clearances and exposing the aircraft to CFIT.

Though the stepped approach let down is permitted by Regulatory Authorities, reservations exist among pilots as to their execution. This is because of the constant power and trims changes that are necessary to achieve the design profile, in what is a messy, high work-load, non-continuous, unstable approach. Those asked to design an intended stepped approach, should endeavour to produce a continuous descent path procedure starting further out, even if it means repositioning an NDB to act as a FAF. A VOR/DME non-precision approach is easier to cater for in this context, because a FAF is more readily defined as a distance from which to start descent.

14.3.5 Cloud-break procedures and Indirect Approaches
(With acknowledgement to the NZ CAA Vector publication for the 'thread')

**A. Circling to land**

A circle-to-land manoeuvre consists of either a visual or an instrument approach to one runway, terminating in a visual landing on another. There is more than one reason for air traffic control to clear an airplane for an approach to one runway and then land on another.

The circling approach is an exacting procedure. Risks can be reduced but there are no shortcuts. Safe circling approaches demand detailed pre-flight planning, practice, a high degree of situational awareness, discipline, careful briefing, strict adherence to the procedure outlined in the AIP and a willingness to execute a missed approach at the first sign of trouble. A circling approach takes place close to the ground, at low speed and in poor visibility and is also a very difficult procedure to practice. It is a visual manoeuvre flown mainly looking out for reference. Above all, pilots must be prepared to carry out a missed approach if the workload becomes unmanageable, or they simply feel uncomfortable with the approach and opt for a diversion to an alternate. A balance needs to be struck in the minds of the crew, between external scanning for visual cues and the need to refer to their instruments.

Circling approaches are not generally used at major airports that are designated as points of entry -international airports-, such as London Heathrow (LHR), probably because precision approach landing aids are available for all runways. Where authorised, circling instructions and minimums for different categories of aircraft, are found at the very bottom of the approach plate. Airlines may use more conservative minimums than those published by the State NAA.

A circling approach must never be carried out without first obtaining ATC clearance for a published instrument approach to one runway until clear of cloud, to then break-off for a circling approach for a visual landing on another runway not aligned with the instrument approach aid to be flown because of the weather.

Be especially vigilant during such an approach option, where the cloud base minima may mean that the ‘target threshold’ is not continuously visible, such as when some scattered clouds below MDA partly cover the manoeuvering area (Common as ‘fair weather Cu’ at around 500 feet in the Caribbean).

Aircraft categories, their circling speed and EASA circling AOM, with the circling area radius for each category, are shown in the table. Minima that are more restrictive may apply for a specific location. The radius of the Circling area for each category is also shown, as is the minimum Obstacle Clearance (OCH) height for the procedure. FAA TERPS circling areas differ from the ICAO standard adopted by EASA, in that the circling radius is less for all categories, resulting in a smaller manoeuvring area.

| Aircraft Category | Vat (knots) | MDA (feet) | Visibility (metres) | Max IAS (Knots) | Circling radius (NM) | Min OC Feet/agl |
|---|---|---|---|---|---|---|
| Cat A | <91 | 400 | 1500 | 100 | 1.68 | 295 |
| Cat B | 91-120 | 500 | 1600 | 135 | 2.66 | 295 |
| Cat C | 121-140 | 600 | 2400 | 180 | 4.20 | 394 |
| Cat D | 141-165 | 700 | 3600 | 205 | 5.28 | 394 |

Where Vat = 1.3 x Vs in the landing configuration at Max Landing Weight

**B. Circling areas**

Circling can be performed only within a specified boundary, known as the circling area. The circling area dimension depends on the performance category of the aircraft.

The circling area is based on arcs centred on the threshold of all usable runways. These arcs are then joined by tangents. The radius of the arcs varies according to aircraft performance category.

How the circling area is defined can be seen in the example (Figure 1). Using the inner boundary for Category B aircraft, arcs centred on each runway threshold are drawn with a radius of 2.66 nm  Straight lines then connect each arc forming the inner circling area boundary. Also shown is the slightly larger Category C circling area at 4.20 NM, which allows for the larger turning radius of faster Category C aircraft types.

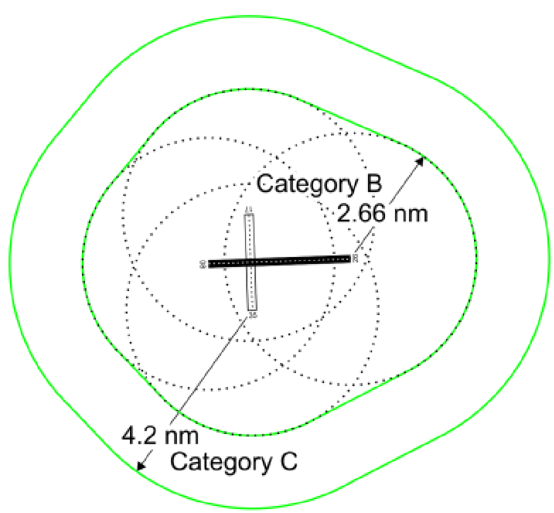



Figure 1 - Circling

Visual circling begins at or above the circling MDA. The MDA is specified on the Instrument Approach Procedure chart. There are two types of MDAs: a circle-to-land MDA, and a straight-in landing MDA. The straight-in landing MDA is only applicable if the landing runway centreline is aligned with the final approach segment of the instrument approach. (In this context, Aligned means within ±30° of the final approach segment for Category A and B aircraft, or within ±15° for category C and D aircraft.) You may descend to the straight-in MDA only if a straight-in landing is intended. If a circling approach is required, you cannot descend below the circling MDA.

Descent below circling MDA may be permissible during daylight hours, providing that **Continuous** visual reference with the runway threshold has been established. However, take note that ICAO Annex 6 has the following definition for "Minimum descent altitude (MDA) or minimum descent height (MDH): *A specified altitude or height in a non-precision approach or circling approach, below which descent must not be made without the required visual reference.*

**Note1:** The Minimum descent altitude (MDA) is referenced to mean sea level and minimum descent height (MDH) is referenced to the aerodrome elevation, or to the threshold elevation if that is more than 2m (7feet) below the aerodrome elevation. MDAs for circling approaches are referenced to the aerodrome elevation.

**Note 2:** The required visual reference means that section of the visual aids or of the approach area, which should have been in view for sufficient time for the pilot to have made an assessment of the aircraft position and rate of change of position, in relation to the desired flight path. In the case of a circling approach the required visual reference is the runway environment." Note that Note 2 requires the **'runway environment'** as the visual reference**.**

This visual reference must be maintained and the aircraft's position 'contained', such that continued descent to complete the landing can take place using only **Normal** circuit manoeuvres and descent rates to the touch-down zone. The aircraft must be kept within the circling area and the visibility must also be equal to or greater than that prescribed for the instrument approach procedure. It is preferable and very strongly recommended NOT to use the "Dive and Drive" technique, because of the inherent dangers of this procedure though it is still authorised by ICAO and Regulators.

For descent below circling MDA at night, there is the additional requirement that the pilot must be able to maintain **continuous** sight of the approach lighting or aerodrome lighting. Beware of the 'black hole effect'. A number of CFIT accidents have occurred during circling approaches at night due to this phenomenon. It is recommended **not** to leave the circling MDA at night until a constant 3° descent profile can be maintained all the way to the runway, using the approach lighting system. This is the safest way to ensure obstacle clearance.

### C. Plan the Approach

If a circling approach is considered, an alternate will also be required. Furthermore, if intermittent conditions are experienced, they may dictate a missed approach and possible diversion to an alternate.

A prudent pilot will have planned for the missed approach and the flight to the alternate. He/she will have also checked whether there was sufficient fuel to conduct another approach, or whether to divert immediately if the first attempt is unsuccessful.

As long as the aircraft is kept in the circling area and clear of obstacles, manoeuvring required to align the aircraft with the intended runway is permitted. In VMC conditions pilots should conform to the published circuit direction. On arriving in the circling area, the primary objective is to sight the intended runway and keep it in sight whilst manoeuvering for a landing.

When planning a circling approach, one should be aware that it is far more difficult to keep the runway in sight if it is on the right hand side of the aircraft. Wherever possible, with the captain flying the approach, the runway should be kept on the left. With this in mind, some possible flight paths are shown for the runways depicted in Figure 2. In the event of a southerly wind, a track that will intercept a left base for Runway 17 is best chosen. Alternatively, one could track overhead the 'navigation-aid' and then make a continuous left hand turn to join left-hand downwind for runway 17. However, if the wind is from the West, the plan should be to plan to track upwind for Runway 26, with a left turn to join a 'left circuit'. In both cases, the approach should be designed to keep the runway in sight throughout, remaining at the circle to land MDA on area QNH and descending only when established on the normal descent profile.

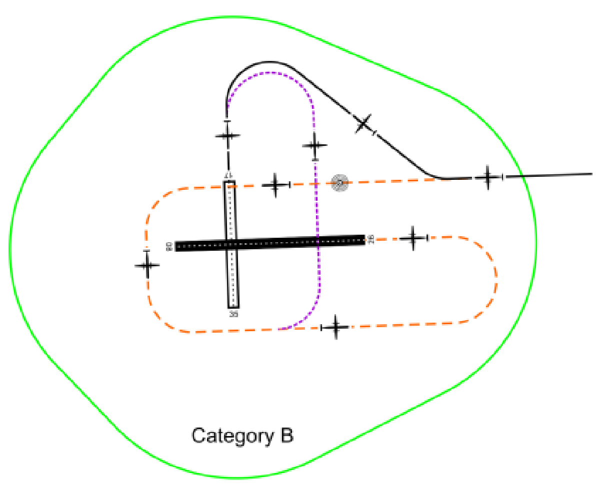



Figure 2 Planning the approach path

In some cases, a let down plate is provided, giving guidance on the pattern for the circling approach. It may also show a preferred track to be flown. Before Top-of-descent from the Cruise, refresh yourself on the Instrument Let-down and Approaches and the distances to be flown. For ease of execution in such cases, distances can usefully be converted to time for the IAS flown and a stop watch used, for better positioning accuracy.

**D. Missed Approach**

If visual reference is lost while circling, a missed approach *must* be executed as specified on the approach chart. Irrespective of the aircraft's location in the circling area, climb towards the landing runway, intercept the missed approach track overhead the runway and continue climbing until the altitude specified in the missed approach procedure is reached. In simple terms, if you lose sight of the runway, particularly at night, your only option is to climb promptly above MDA.

14.3.6 Instrument Approach Minimum Descent limits

Precision Instrument Approach descent minimums are referenced to the Runway and referred to as Decision Height/Altitude (DH/DA)

Non-precision Approach descent minimums are referenced to the Height of the airport and referred to as Minimum Descent Height/Altitude (MDH/MDA). They are NOT referenced to the Threshold Height of the runway served by the let-down used for landing, or to break cloud followed by a landing on a different runway (Indirect Approach).

14.3.7 The Rushed Approach

To avoid a rushed approach, aim for 4 successive 'gates' depending upon your company SOP:

Gate 1: 33nm /10,000 feet - Start deceleration from 250 knots to first flap limiting speed
Gate 2: 30nm / 9,000 feet - A clean aircraft will parallel the 3º glide slope
Gate 3: 20nm / 6,000 feet - Extend initial flap
Gate 4: 7nm / 2,100 feet - Select intermediate flap and wait for 1½ dots up from the glide-slope to extend the undercarriage, then landing flap as you intercept the glide-slope and fly it to touchdown.

14.3.8 Instrument Approaches – General Considerations
With thanks to Captain Paul Wilson, FRAeS

Point 1: The distinction between angular deflection from a centreline heading and distance from the centreline at various distances is an issue that is not often appreciated. If you are 'one dot off' all the way to touchdown, you are still closing the centreline or glide-slope and will not be so far off as not to be able to land. However, flying below the glide-slope should be avoided.

Point 2: On a non-precision instrument approach (NPA), there will be a need to re-join the glide path or approach slope from above, when descent from the platform altitude is started on passing the Final Approach Fix (FAF). When on an ILS, the glide path can be seen approaching as the aircraft flies towards it and landing gear and flaps can then be extended 'on schedule'. However, to regain the correct glide path /slope when on a NPA, the approach is more untidy of necessity. The need for a slightly increased rate of descent from the desired target figure of around 700 feet per minute must be anticipated and landing flap extended expeditiously, with a smooth but positive downwards control movement and up to maybe 1000 feet/min initially, to regain the desired path. Power and trim changes will need to be addressed and a stabilised approach resumed. Exceeding 1,000 ft/min descent can lead to an uncomfortable Pilot Induced Oscillation (PIO). A delicate touch is needed when performing this manoeuvre. Keep it all smooth for the sake of your passengers.

Point 3: Dialling-in the speed for the auto-throttle to follow should not become such a habit as to neglect to monitor the power settings appropriate to the approach. Get to know your power settings, with the approximate thrust lever angles in aircraft where these move and also aircraft attitude for landing-weight configurations. They may come in useful one day when your ASI fails!

Point 4: When there is a strong cross wind and a low cloud base with poor visibility on an approach, then brief the crew where to look on the windscreen to expect first sight of the runway.

**SECTION 15 - HANDLING CHECKLISTS**
Researched by Captain Ralph Kohn, FRAeS.

Manuals and checklists are kept to a minimum in size in order to make them easy to use on the flight deck. At the same time, text size should be kept well above the minimum required for bare legibility, since they may well have to be read under poor lighting conditions by a short-sighted crew that might already have a high workload.

It is also important that the amount of information included in documentation is relevant to the needs of the pilot and that it is presented in easily understood language, in a typeface that maximizes legibility. Upper case text and italics may be useful in conveying emphasis, but it is interesting to note that neither of these is as fast to read as normal text. THUS LONG MESSAGES, IN UPPER CASE, SUCH AS THIS, SHOULD BE AVOIDED SINCE WORD SHAPE - WHICH ACTS AS A CUE IN READING - IS ESSENTIALLY LOST. Colour may be a preferable way of categorizing information and giving importance to different sections of text, but the legibility of different text/background combinations varies widely. As an example, red text on a white background may become effectively invisible under red light

In using checklists, it is important for the pilot to discipline himself to adhere to the approved procedure. If the checklist calls for a challenge and response, then this is the way in which it should be used. Do also recognise that some ‘checklists’ confirm that actions have been done, whereas others are ‘Do’ lists that require sequential action(s), followed by a verbal or silent ‘confirmation’. Two common problems arise in the use of checklists. The first is that items may be omitted, often because the progress of the checklist is interrupted by an external event (e.g. copying a clearance), or simply because a pilot, using his thumb as a marker, adjusts his grip on the checklist and misses an item. Some aircraft have been fitted with mechanical checklists for important items which enable sliding windows to cover items that have been actioned, and checklists have also been produced in plastic that enable completed items to be marked with erasable pen. In the absence of such aids, the pilot should be aware of the ease with which checklist items can be missed, taking special care when resuming an interrupted check. If in any doubt, the professional airman goes back to the beginning of that checklist, to check that every action has been completed within it thus far.

Another major source of error in using routine checklists is that they may be responded to automatically rather than diligently. It is tempting for the pilot to regard a rapid dismissal of checklist items as indicative of his skill and familiarity with the aircraft, but, if checklists are dealt with in this automatic way, it is very easy for the pilot to see what he expects to see rather than what is there. Although it may be difficult to devote care to a procedure that has become routine, this is exactly what the pilot is required to do.

With familiarity, the litany of the normal checklist becomes second nature, so that an omission from the part of the reader will stand out and shout “missed item”. Remain aware of the vital need to use all checklists methodically and accurately. Do not rush pre-flight drills. Deliberate movements to position switches from an ‘as found’ position to the correctly identified selection are of the essence. Scan speed comes in time, with familiarity as experience builds up in any new environment.

## SECTION 16 - THE GLASS COCKPIT

Researched by Captain Ralph Kohn, FRAeS.

### 16.1 PREAMBLE

It is generally true to say that before the introduction of computers into commercial aircraft, cockpits were inevitably complex. This was because every sensor in the aircraft (whether of airspeed, oil quantity, or cabin altitude) was connected to its own display on the flight deck and the value of that parameter was thus constantly displayed. The two major changes that the automation has enabled are that the computer is able to receive information from many data sources and integrate it into a single comprehensive display, and that the computer can also be selective with regard to the amount and type of information that is displayed at any given time.

The best example of the integration of information is in the navigation or horizontal situation displays found in advanced flight decks. These take information from many data sources, such as ground radio aids, the aircraft's inertial platform, and weather and ground mapping radar, to present a single integrated picture to the pilot of all available information relating to the two horizontal dimensions. The pilot is thus freed not only from the requirement to integrate the information from these data sources for him or herself, but is also freed of many inferential tasks (such as calculating wind strength and direction) that are also carried out by the computer.

Ideally, being relieved of tasks that can be automated should leave the pilot better able to make the higher level decisions that only he can make and give him much improved 'situational awareness'. This is certainly so, but it is also possible that by providing the pilot with such an attractive and compelling display, he may have been distanced from the real world and tend to believe exactly what the display tells him, rather than regarding it as information from which to build an internal model of the real world.

The selective nature of displayed information in glass cockpits is exemplified by current aircraft status displays, which provide information of, e.g., control surfaces, wheel temperatures and pressures, or cabin temperature and pressure, automatically tailored to the pilot's activity and the phase of flight. Although this approach undoubtedly acts further to reduce pilot workload, there is the possibility of the pilot remaining unaware of important information when solving an unusual and unexpected problem.

CRT displays also enable the wide-ranging and flexibility of colour, but this facility should normally be employed with restraint. Colour is useful in all types of display for categorizing information and some standards and conventions already exist in this regard. Flashing red should be used only for information requiring immediate attention, red and yellow or amber for less immediate problems, and white and green for satisfactory or non-critical information. In the glass cockpit, it is possible for the colour of symbology to change to indicate a change of state, for example, from 'ALT (altitude) Capture' (in blue) to 'ALT Hold' (in green). Such colour changes are normally useful, but flight decks should not be designed so that the state of a variable is indicated only by colour, with no associated change of caption text or location.

Although the term 'glass cockpit' derives from the use of cathode ray tube (CRT) displays, such aircraft also tend to contain automation of controls. Since such flying controls may be limited in their authority by the aircraft's computers to a safe flying envelope (e.g. making the aircraft impossible to stall), there is a danger that the pilot may come to regard the aircraft as infallible, and able to cope with impossible situations. It is no use, for example, to be flying an aircraft that ‘cannot be stalled’ if the pilot has placed it at low level and low airspeed, with no energy available to fly away from the problem. Automated aircraft do not, therefore, absolve the pilot from operating in a way that complies with the basic requirements of safe flight.

Other problems perceived by the pilots of 'glass cockpit' aircraft are that the displays are so easy to use that they may make it difficult when they fail, when the pilot has to use his traditional skills at basic instrument flight. This might be especially true for young pilots, who do not have any depth of experience on aircraft that are more basic. Another concern is that the complex systems which drive the modern pilot/equipment interface cannot be understood by pilots to the same extent that more basic systems could, partly as a direct result of the complexity, and partly as a result of 'need to know' mechanized teaching methods. It is for these reasons that the pilots of such aircraft can frequently be heard, saying either 'What's it doing now?' or 'I've never seen it do that before.'

Lastly, but perhaps most importantly, glass cockpits do appear to produce the problem of what might be termed 'mode awareness'. Since the automatic flight and engine management systems can be set up in so many 'modes', it is possible for the pilot to believe that the aircraft is programmed to carry out one function when it is, in fact, performing another.

It is plainly important for the pilots of such aircraft to maintain an accurate knowledge of the aircraft's status by including the mode representation as a central part of their scan. It is therefore important for designers to ensure that mode information is always centrally, unambiguously and clearly displayed.

**16.2 INTELLIGENT FLIGHT DECKS**

There is no precise line that divides the 'automated' from the 'intelligent', but the sophistication of the data evaluation and problem solving, of which modern aircraft are capable, would appear to merit the use of terms such as 'pilot's associate' and 'electronic crew member'. There are probably three main human factors issues, presently unresolved, that may be identified.

The first concerns the level of autonomy given to the machine. Should the computer be permitted to evaluate data, make decisions, and execute them without reference to the pilot, or should it take a more advisory role, presenting suggestions to the pilot to help him to make the decisions? For example, should an aircraft fitted with a traffic collision avoidance system be permitted to alter the aircraft's flight path if it detects a potential conflict? Many such problems will be solved individually, but it is widely felt that a philosophy should be developed of how the pilot and machine should interact, and to decide whether future aircraft should be 'human centred' or 'automation centred'.

The second concerns the representation of uncertainty. As machines become more sophisticated and as they evaluate greater quantities of possibly 'noisy' data, so do the solutions they arrive at become more 'probabilistic' and less 'deterministic'. Presently, aircraft displays do not tend to give the pilot any estimate of the reliability of the data displayed. They simply display the machine's best guess. An example of this is the navigation display in glass cockpits. The aircraft's position is computed on the basis of GPS data or inertial navigation, with references to ground based aids, but more or less the same display is given to the pilot. This is provided, regardless of whether the aircraft 'knows' that good data is being received from all sources, or whether it 'knows' that it is receiving information from one, poor quality, distant DME and an inertial system that may have been drifting for four hours.

The third issue stems from the two ‘above and concerns 'trust'. The pilot obviously needs to have an appropriate level of trust in his equipment, since ‘*Overtrust’* has obvious dangers and *‘Undertrust’* can lead to unnecessary workload and operational difficulties. The operational reliability of systems is plainly an important determinant of the level of trust that pilots have in their equipment, but it is also possible that modern displays may be so compelling that they engender more trust in them than they actually merit; witness the outputs obtained from some computers … “It MUST be right because the computer printed it !...”.

**16.3 BOREDOM AND MAINTAINING SKILLS**

Highly automated flight decks and extended range operations have developed more or less concurrently. This means that the cruise phase of flight leaves the pilot with little to do, but may continue for as much as 14 hours. The problems of both boredom and loss of handling skills are apparent. In such long haul operations, the problems may be exacerbated by the requirement to carry two crews in order to comply with flight duty time regulations.

It is plainly unsatisfactory for crews to become bored, since this may lead to not only reduced monitoring of their environment and consequently reduced situational awareness, but may even lead to their falling asleep. Even more serious is the possibility that a bored crew may be tempted to experiment with systems on the flight deck. This has already led to at least one serious incident in which the crew, attempting to discover how certain aspects of the aircraft's auto-throttle operated, disabled the engine management system to the extent that fan blades were shed by an engine, penetrated the fuselage and a passenger was lost through the hole.

**SECTION 17- FLIGHT IN SNOW, SLUSH AND ICING CONDITIONS**
by Captain Ralph Kohn, FRAeS.

Cold weather operations can present flight crew and ground staff with a potentially dangerous but avoidable challenge to aircraft safety. Frozen contamination, like ice on a wing or control surface is dangerous because there is no known reliable piloting technique for recovering an aircraft from wing stall during, or shortly after take-off because of ice contamination. Aircraft systems can also be affected by the accumulation of frozen contamination. In some cases, accumulated contamination within engine intakes could cause an engine to flame out. A review of recent incidents revealed two such examples. In the first, the aircraft suffered a double-engine flameout as it was lining up for take-off.
In the second case, the crew were not so fortunate. The flameout occurred shortly after take-off resulting in the aircraft ditching, with the tragic loss of both crew members.

Clearly, it is essential that aircraft critical surfaces are cleared of and remain free from frozen contaminants while the aircraft is still on the ground. This is achieved by a variety of methods, ranging from keeping the aircraft in the hangar through to de-icing and anti-icing using high tech fluids. To confirm that the vitally necessary de-icing has been carried out as requested, a check of the top surfaces of the wings from inside the cabin is strongly recommended, particularly at night, using wing flood lights or a hand held torch, to ensure that de-icing has cleared the wings' top surfaces from snow and/or ice contamination. This is no easy task and it is to be hoped that Type Specific training and guidance would have been provided, to enable this.

Passengers may wonder and feel uncomfortable about seeing a pilot or engineer checking the wing in this manner, so a few explanatory words would dispel concerns. The point to make is that in the interests of safety, a check is being made to ensure that de-icing fluids applied to the aircraft have effectively removed all snow and ice deposits from the upper wing surface, which must be clean of such contamination that is not visible from the ground. A clean aircraft is a vital essential for flight and the check being carried out is part of the procedure to ensure a safe take-off.

The fundamental objective to achieving contamination-free critical surfaces is good communication between aircraft operators, ground-handling agencies, airfield operations and, of course, air traffic control. In fact, everyone involved in aircraft ground icing operations should have a clear understanding of their responsibilities and how they can positively contribute to the team effort.

The UK CAA has always been at the cutting edge of ground icing issues and has consistently sought to improve standards. Yet despite this, ground icing-related incidents continue to occur. The UK CAA created a focal point within the Operating Standards Division to examine why these incidents continue to occur and to formulate an appropriate response in order to promote flight safety further. This focal point or ground icing 'gateway', as it is known in the CAA, consists of representatives from flight operations, maintenance standards and research management.

In 2004, it was decided that the first output from the gateway should be a film and a publicity campaign designed to highlight the dangers of ground ice and to promote a better understanding of what each member of the industry de-icing team is required to do.

The ***Ice Aware*** film was produced in conjunction with representatives of the industry. Judging from the feedback received, the film has been a great success.

Following on from the success of the 'Ice Aware' film the CAA has now updated it for the 2005/6 winter season and incorporated new footage showing various aspects of de-icing fluids. The film, previously released on CD-ROM, is now available in DVD format and is available free from the address below.

In addition to the 'Ice Aware' film, the gateway has been actively involved in the production of a web based training (WBT) aid. This free Internet on-line course, entitled A Pilots Guide to Ground Icing, is intended primarily for professional pilots who make their own operational de-icing and anti-icing decisions. This includes pilots who fly business, corporate, air taxi, or freight operations in fixed wing aircraft, ranging from business jets to single engine turboprops.

The course discusses the risks of contamination, cues to alert the pilot to ground icing hazards and actions to help ensure safe operations. Imagery, case studies, pilot testimonials and interactive elements are used to inform the pilot and help him or her make better operational decisions. The course has region-specific differences incorporated (where required) and is an invaluable tool for pilots to enhance their knowledge base.

An international team of experts in icing, de-icing and anti-icing fluids and end-user pilot trainers developed the course. This multi-national team comprised representatives from CAA, NASA, FAA, Transport Canada, West Jet, Flight Options and the University of Oregon. Collaboration with the aforementioned international team of experts has produced the free web-based training (WBT) package titled ***A Pilot's Guide to Ground Icing***. There is also a course captioned ***A Pilot's Guide to In-flight Icing.*** While these first training packages are aimed at the target audience mentioned above, it is likely that further variants will be produced in the future for other sectors within the industry.

Clearly, it is imperative that pilots are equipped to take good operational decisions. These new training aids enhance the basis on which those decisions may be made. Ultimately, though, ground icing operations are a team effort and as the UK CAA presenter says in the ***Ice Aware*** film: *"As you operate rigorous schedules in challenging weather conditions, it is your professional judgement and good safe procedures that can make a significant contribution to flight safety".*

The UK Civil Aviation Authority (CAA) new free DVD on the subject of cold weather operations is now available. For ease of reference, more details of available information on the subject of Operations in inclement winter weather, like snow, slush or icing and on the two web-based courses, may be found in Appendix 2 of this Specialist Document.

Copies of the DVD are available through UK CAA Flight Operations Inspectors or alternatively by e-mail request to: **Alison.Jarvis@srg.caa.co.uk**

The free *'Ground Icing'* and *'In-flight Icing'* WBT's are available at: **http://aircrafticing.grc.nasa.gov/index.html**

PD Photo: icebox.grc.nasa.gov/images/banners/education_lg.jpg

**SECTION 18 - GROSS ERROR CHECKS**
by Captain Ralph Kohn, FRAeS

**18.1 DEALING WITH LOAD-SHEETS**

Load-sheets are a potential source of gross, indeed sometimes fatal, error and remain an area where constant vigilance is essential. Therefore, this is the first heading under which the subject of gross error checks that pilots need to carry out in order to stay alive, is discussed in this Section.

In the same way as needing to have a pretty good idea where the decimal point will appear in the result when using a hand held calculator, it is vitally important to make sure that when a load-sheet is offered by a traffic officer for the captain's signature, it reflects the true aircraft gross weight at take-off. The ball-park take-off weight should already be in each pilot's' mind, having been roughly calculated whilst progressing through pre-flight planning activities.

All it takes is a bit of organisation from the part of the company on one hand and some simple arithmetical addition from the part of the pilots on the other, to establish a 'ball park' figure of the expected take-off weight, so that the correct Vital (V) speeds for use during take-off are extracted and used.

A number of accidents and incidents have occurred when wrong V speeds were extracted and incorrectly used after the captain accepted the load-sheet presented by the Traffic Officer, complete with glaring errors. In the case of at least one B747 departure, the V-speeds used were for the landing weight that was incorrectly shown as the take-off weight. When presented with the load-sheet to sign, the captain had not realised that landing weight and take-of weights were identical. As a result, the aircraft scraped the tail on the runway during rotation at VR, staggered into the air at V2 and barely made it round the circuit for an emergency return to the airport for a landing. Extensive damage was caused. That a major accident had not occurred was only because of the handling ability of the pilot but most certainly not for his pre-flight preparation skills!

When dealing with pre-flight briefing matters, establish from the navigation flight plan the minimum fuel required for the flight after the weather forecast has been received and the alternate(s) nominated. Then, with the help of the 'dispatcher' or Traffic officer responsible for preparing the flight's load- sheet, it is a simple matter to obtain the forecast load for the trip is (be it in kilos or pounds) and pre-calculate an approximate take-off weight as follows :

Note the number of passengers (x100 kilos per head, to include passenger average weight + the maximum 30 kilos baggage allowed per person) and arrive at an initial figure. To this is added the weight of any cargo/freight expected. Add the 'final fuel' load requested, to obtain an approximate commercial load + fuel on board weight. Note this total weight of fuel plus expected load, for later use when the load-sheet is presented. Many captains put a hand-written note on to their flight plan documents as an' *aide mémoire',* as often do prudent F/Os and E/Os, independently.

'Final fuel' includes the required flight-plan fuel and normal reserves for holding and diversion + any extra fuel intended as a buffer for contingencies at destination, if weather is doubtful, or if known 'holding' delays are known and can be expected.

The check does not stop there. On entering the flight deck, the first thing one must do is to look at the aircraft's documents folder to confirm that it is the correct folder and that its contents correctly refer to the aircraft boarded (by Registration). This may be verified by comparing details of the aircraft shown on the documents with the Registration letters/number usually painted on both pilots' instrument panels, for ease of reference in flight. If the aircraft Registration is not so shown on the flight deck, the Company should seriously consider providing this information on all its aircraft. In addition, 'Maintenance' could usefully provide a small card with the aircraft's current APS weight and Index, inserted in a holder mounted on the instrument panel in front of the Captain. Additionally, below the aircraft registration, the HF and VHF radio Selective Call ('Sel-Cal') codes should also be painted on to the Instrument panel. (See 18.4 for contents of the folder)

The contents of the Documents folder must then be checked against the list that should be on its cover, to verify that it holds all the certificates that are required by Law to be carried (also see Appendix 6 for excerpts of the relevant Air Navigation Order Schedules). During this check, the APS weight and Index are checked <u>and noted</u> by the pilot and/or compared with the placarded data provided by 'Maintenance' as explained in the previous paragraph, to confirm both figures tally. The APS weight is now added to the figure of expected commercial load plus fuel-on-board calculated earlier and a gross 'ball-park' take-off weight is arrived at.

When the load sheet is presented, it then becomes an easy task to confirm the APS weight and Index used by its compiler are correct, by comparing them with the figures on the placard mounted on the I/F panel, or previously extracted at the time of the Documents folder contents check. The previously estimated 'gross' total of load, plus fuel, plus basic APS weight is now compared with the load-sheet take-off weight shown on the form presented for signature. The two should be pretty close. Any discrepancy noted should be queried and accounted for, with agreement by all the flight crew. Finally, any Last Minute Changes (LMC) will be addressed and the load-sheet signed. This LMC difference can mean a review of the take-off runway intended, together with many other changes required, such as a revised departure route to that already loaded in the FMCs. If you were at or close to MTOW and the ground staff have not realised this, then the LMC may have to be declined, at the cost of a possible service delay.

Now and now only, are take-off V speeds extracted for the calculated (and now double checked) take-off weight, which are then 'bugged' on Air Speed Indicators and the weight loaded into the Flight Management Systems computer.

### 18.2 GROSS ERROR CHECKS EN-ROUTE

Stay alive to where you are in spatial terms at all times and sharpen your situational awareness skills to achieve this. The following story contributed by Dr John C. Barnett of the Flight Operations Group, illustrates well the need to carry out gross error checks to reject conflicting information.

A pilot on a cross country flight off the West of Scotland sought a back-up bearing and range from the Macrihanish (MAC) VOR on Kintyre using a portable yoke-mounted GPS receiver. The figures came back almost instantly from that wonderful contrivance but thankfully, the pilot's situational awareness led him to question the answers. The bearing did not line-up with the situation the pilot saw either from his ADF, or from his chart, or from his window and the distance to the beacon seemed ridiculously high. Why was that? In the close confines of a PA28 cockpit and with the intriguingly complex means of entering the selected waypoint into a GPS provided with the maximum of button functionality and the minimum of screen size, the pilot had mistakenly entered the MAC VOR as MAG which is somewhere west of Berlin !

This was an obvious error easily spotted because of the magnitude of the distance from the reference point entered. However, it could have been a much smaller figure that might have lulled the pilot into a false sense of security. Yet his gross error check allied to good Situational Awareness had him reject the calculated data and query the reason why he got such a wrong result.

### 18.3 GROSS ERROR CHECKS DURING APPROACHES TO LAND

On both ILS Precision Approaches and on all Non-Precision Approaches, it is vital to check the *published* height of the let-down approach path given on the instrument approach plate at a given distance, usually at about 5 nautical miles and compare it with that *achieved* during the approach. The geographical location of the point is either established by way of a Non-directional Beacon (NDB) or a fan marker, or it is established via a DME reading from the ILS installation, or from a nominated VOR on or near the airfield.

In the case of a precision approach, passing the 'Marker, whilst 'on the glide path' and at the published height, confirms that the aircraft is established on the correct approach slope and not on one of the other 'spurious' or 'false lobes' that radiate in addition to the calibrated ILS installation 'on glide slope' beam.

It is good airmanship and a very good discipline on all Approaches for each flight-deck crew member to confirm *'Passing the Marker and the Height Checks'* as an intercom call, with each crew-member present included in the confirmation cross-check. Passing the 'Marker' at the published height on a non–precision approach, allows final descent to commence from a known height and at a known distance, at a predetermined rate of descent for the approach speed, to achieve a constant stabilised approach all the way to touchdown.

### 18.4 THE CONTENTS OF THE DOCUMENTS FOLDER

The Documents' Folder should include:

1. The Certificate of Airworthiness; where the certificate of airworthiness includes the flight manual for the aircraft. With the permission of the CAA, the Flight Manual does not need to be carried as part of this document, if an Operations Manual containing all the necessary data and information is on board.
2. The Certificate of Registration
3. The Aircraft Weight Schedule (showing the APS weight and Index)
4. A current Radio station installation licence (required under the Wireless Telegraphy Act (1949)
5. The Insurance certificate

In addition, the following documents must also be carried

6. The technical log in which entries are required to be made in case of systems' malfunctions noted during sectors to be flown with and the separate Cabin Defects log, where this is used,
7. One copy of each certificate of maintenance review in force, in respect of the aircraft;
8. The licences of the members of the flight crew of the aircraft;
9. A copy of the load-sheet in respect of the flight;
10. Those parts of the operations manual required to be carried on the flight (This does not include the Training Manual);
11. A copy of the notified procedures to be followed by the pilot in command of an intercepted aircraft, and the notified visual signals for use by intercepting and intercepted aircraft;
12. The permission not to carry the Flight Manual. With CAA permission, this need not be carried if an operations manual is carried which includes the particulars specified at sub-paragraph (1) (q) of Part A of Schedule 9 (see Appendix 4).
13. Crew Passports. Since the UK has not signed the Schengen Agreement, passports will be required if requested by the appropriate authority. Passports are always required when operating outside the EEC.

## SECTION 19 - SITUATIONAL AWARENESS

Compilation by Captain Ralph Kohn, FRAeS

*"Fortune favours a prepared mind"*. (Louis Pasteur). Simply put, *situational awareness* (or SA), *is KNOWING what is going on around you.*

Situational awareness involves three phases:

1. *Perception:* Noticing and gathering relevant data.
2. *Comprehension:* Generating a mental picture of the situation.
3. *Projection:* Anticipating what is coming next and how to respond.

Most of us suffer from too much information and not enough situational awareness. We have more data than ever before, but most of us are less informed than ever before. There is so much information to be sorted and interpreted that it presents an ongoing problem, whether the job is in a cockpit or behind a desk.

It is reported that in aviation 76 percent of situational awareness errors occur in the perception phase, but error rates decline as you move through the process – to 20 percent in comprehension and to 4 percent in projection.

### 19.1 PERCEPTION, THE MOST IMPORTANT ASPECT

#### 19.1.1 Heads down & nobody flying the aeroplane?

Remember Eastern flight 401, the Lockheed 1011 TriStar that crashed in the Everglades? More than 30 years later this doomed flight still teaches a powerful lesson. In this crash, a pilot, his co-pilot and a flight engineer were so preoccupied with a malfunctioning 'undercarriage down and locked' green light that was not illuminated, that they completely lost situational awareness.

According to their flight recorder, they spent their last moments second guessing their altitude – thinking they were at 2,000 feet when they were actually at 100 feet, at night on approach to the airport, with all three of them trying to work out why the undercarriage down indications were not normal and no one positively keeping an eye on the autopilot that was flying the aircraft. The aircraft gradually descended unobserved as the autopilot was in 'Control Wheel Steering' mode and the Captain was gently leaning on the yoke in front of him, until it hit the swamp, killing all on board. The crew's perception was so dangerously skewed that they were completely blind to the most critical information, namely the reality of their current situation.

It is an instructive case that illustrates how perception is the most important element in situational awareness.

#### 19.1.2 Loss of Situation Awareness?

Then there is the case of the Controlled Flight into Terrain, of American Airlines Flight 965, a Boeing 757-223, registration N651AA, near Cali, Colombia on 20 December 1995. While descending into the Cali area, at night and in visual meteorological conditions (VMC), the aircraft struck some trees and then crashed into the side of a mountain near Buja, Columbia. Yet they were 33 nautical miles from the Cali (CLO) VOR navigation aid. The aircraft was destroyed and all but 4 of the 163 passengers and crew on board were killed.

The accident aircraft hit mountainous terrain, while attempting to perform a GPWS escape manoeuvre, about 10 miles east of where it was supposed to be on the instrument arrival path to Cali Runway 19. Approaching from the north, the crew had been expecting to use Runway 1, the same asphalt but in the reciprocal direction, which would require flying past the airport and turning back; the usual procedure.

They were offered, and accepted, a 'straight-in' arrival and approach to Runway 19, giving them less time and therefore requiring an expedited descent, initiated with the assistance of deployed speed-brakes for an increased rate of descent. They were told to report reaching Tulua VOR that is 34 nautical miles North of Cali Airport and marks the start of the

Rozo One VOR/DME approach. Rozo is a non-directional navigation beacon (NDB) located 2.7n.miles North of Cali Airport on the approach to Runway 19. The aircraft, however, had already passed the Tulua VOR, but the pilots apparently had not realised this.

The crewmembers were not familiar with the 'ROZO One' arrival they had been given. They became confused over the clearance and spent time trying to program the FMC (Flight Management Computer) to fly the clearance they thought they had been given. When they finally entered Tulua on the FMS, the aircraft began a fatal 90 degrees left turn (initially eastward) to return to Tulua which by now was behind them, unbeknown to the pilots who, after a while, then selected Heading Mode on the FMS and turned the aircraft to the right so as to fly towards Cali, or so they thought. The aircraft hit the mountain with the ground-proximity-warning system ordering "pull-up". The speed-brakes were still deployed !

Confusion over two navigation beacons in the area with the same identifier and frequency led to the aircraft under autopilot/FMC control turning left away from the arrival path. The crew did not notice this for 90 seconds. When they noticed, they chose to fly the 'inbound heading', that is, parallel to their cleared path. However, they had not arrested their high rate of descent using speed-brakes and were in mountainous terrain. Continued descent took them into a mountain area and the GPWS (Ground Proximity Warning System) sounded. The escape manoeuvre was executed imprecisely, with the speed-brakes left out, as the aircraft flew to impact.

The US National Transportation Safety Board believes that had the manoeuvre been executed precisely, the aircraft could possibly have cleared the terrain. However, the aircraft should never have been so far off course, so low.

*Clearly, the rushed approach and a total loss of Situational Awareness were the major causes of this unnecessary accident.*

Primary reasons for this loss of awareness of their position include the failure of the flight crew to revert to basic radio navigation, at the time when the FMS-assisted navigation became confusing and demanded an excessive workload in a critical phase of the flight. The history of the flight indicates that the AA965 flight crew did not effectively use all navigation information that was available to them and that they relied almost exclusively on their EHSI for navigation. They seemingly lost awareness of the terrain they were flying over.

Secondary reasons include the fact that, unlike charts, the FMS-generated displays do not present associated information, such as terrain and do not display nav-aids that are behind the airplane unless specifically directed to by a flight crew member. As a result, pilots who are accustomed to relying exclusively on FMS-generated displays for navigation, can, over time, fail to recognize the relative proximity of terrain and can lose the ability to determine quickly that a fix or beacon is behind them. Evidence suggests that this partially explains the difficulty of the AA965 flight crew in locating the Tula VOR (ULQ).

19.1.3 Distractions?

Do not allow peripheral matters to distract you from the primary task you are engaged in and remember that other humans in the picture, controllers and all levels of management, can directly impinge on your performance and that of the system as a whole. Do not allow their interference to divert your attention. In this context, the following contribution from Dr John C Barnett FRAeS, of the RAeS Flight Operations Group (FOG) is of interest.

*An actual case, this time taken from the rail industry is a good example of such distraction. A train driver was having an intermittent fault with the windscreen wipers of his locomotive. He had just left a station when it started to rain heavily and the wipers stopped for good. He advised the railway's control office by radio and an experienced controller helpfully advised the driver to check a particular circuit breaker located on the panel behind him. The driver turned round to the panel just as he was approaching a signal which was displaying a red (stop) aspect and immediately went past the signal resulting in a Signal Passed at Danger (SPAD) event. In this case, the consequence was slight but the potential risk was great. Both the driver and the controller had lost situational awareness, the driver principally for forgetting that his primary job was to drive the train and obey the signals – not repair faults whilst on the move, but also the controller for not ensuring that his helpfulness was not going to cause the driver to confuse the important with the (seemingly) urgent.*

## 19.2 SITUATIONAL AWARENESS IDENTIFIES MANY "TRAPS"

1. Focusing on the correct information at the right time
2. If something does not look or feel right, it probably is not
3. Watch out when you are busy or bored
4. Habits are hard to break
5. Expectation can reduce awareness
6. Things that take longer are less likely to get done right
7. Reliable systems are not always reliable
8. It is hard to detect something that is not there
9. Automation keeps secrets
10. Distractions come in many forms

Developing the ability to become fully aware of one's situation is a learned behaviour that must be taught and continuously practiced before it becomes an accomplished and innate skill.

Three components need focusing on:

1. Remain aware of the airplane, its path and the ‘peopled’ environment around you;
2. Monitor and evaluate these three things on an ongoing basis, but you need to anticipate what is going to happen in the future; and
3. Consider contingencies and the unforeseen. Anticipate the possibilities as the dynamic situation develops around you and consider what might happen in the immediate future if no action is taken.

The general trend for cockpit automation is to reduce workload when it is already low (at cruise) and increase workload when it is already high (during departure and arrival), a phenomenon known as “clumsy automation.” This workload distribution is due, in large part, to the high cognitive demands imposed by planning and instructing automated systems (i.e., the demands of data entry associated with the frequent route and altitude changes occurring in the terminal area). Particular care must therefore be taken to remain *Situationally Aware* during periods of high workload and to make sure one of the pilots always ‘*minding the shop’* whilst the other deals with re-programming the “automatics”.

### 19.3 MINIMUM SAFE ALTITUDE (MSA)

Consider at all times the Minimum Safe Altitude (MSA) of the terrain you are operating over, in relation to an engine-out case and the aircraft’s drift down profile down to the stabilising altitude, on every leg of a flight as you pass a waypoint, particularly as you approach mountainous terrain.

#### 19.3.1 Departing

On departure, you must not only note the MSA to 25 nautical miles but must also consider the MSA all the way to the Top of Climb. For example, when departing Zurich for Milan, the 25 miles MSA is 6000 feet, becoming 14,100 feet at 29 miles, only 4 miles further along! It is therefore vital to consider the MSA beyond the 25 mile range of the SID plate, up to Cruise altitude.

#### 19.3.2 En route

Remain similarly aware at all times of your MSA as you pass a Waypoint, particularly if there are mountains ahead as you travel towards high ground below you. A Drift-down and Stabilising altitude graph or table, should be readily available to hand at all times, so that it can be consulted immediately should an engine failure occur at any time. It should indicate the target IAS to fly at, with remaining engine(s) set to Maximum Continuous Power (MCP). Doing this will achieve the graph’s profile and show how rapidly the aircraft will descend immediately after the failure, before the descent flattens out and stabilising altitude is reached and also how far the stabilising altitude is, ahead of the aircraft. This allows a decision to be made.

If the failure occurs immediately above the highest ground, say Mont Blanc when Northbound on the way to Northern Europe somewhere, with Geneva on the other side virtually in sight, then it is safe to continue past the mountain range. Only then can you drift-down, arrive at stabilising altitude, provided it is above MSA after Mont Blanc, then continue down into the Geneva 25-mile MSA area on the other side. Now you could divert to it for an en-route landing, certainly if on a twin-engine aircraft. If the failure occurs well before Mont Blanc, depending on how far before, if stabilising altitude happens to be below MSA and will be reached before the mountain range, then a turn back is indicated for a landing at an airfield South of the Alps, such as Milan or Turin.

Remain aware that even with MCP selected on the live engine(s), the aircraft drift-down profile is not a straight line. It starts as a rather steep curve that flattens-out as stabilising altitude is approached. This needs to be considered whenever the distance to stabilising altitude data is consulted, when approaching a mountain range, to establish whether the aircraft can safely descend and successfully negotiate passing over the mountains, to stabilise at the MSA beyond it. But there could well be an urgent need to turn back, because stabilising altitude is below MSA for the over-flight of the high ground that will be reached before getting to it.

Green-coloured MSA contour envelopes showing the safe altitude one can maintain, is a preferred method of showing high terrain, as developed by the British Airways Aerad (now Thales) team, many years ago. Within the envelope, is a 2 or 3 digit number such as **25** or **103,** meaning the MSA is respectively, **2,500** or **10,300 feet** high. This method of depicting terrain and how low one can safely fly above this, is approved in the ICAO Annex 4 Cartographers’ supplement, as an alternative to terrain contours and ‘spot’ heights, to which a pilot must then add the appropriate minimum clearance margins, to obtain the MSA. This latter presentation is more time consuming to use and less readily interpreted. It therefore is more *pilot-unfriendly*.

#### 19.3.3 Arriving

A radar arrival chart, centred on a VOR in the terminal area close to or on the destination airfield, with MSA contours shown thereon, together with a 50 mile range 'dartboard' to show the VOR quadrants and 10 nautical mile range circles, is a most useful tool to confirm an aircraft position whilst approaching an airfield in a mountainous Terminal Area. Aircraft position can be established on a distance and bearing basis from the VOR, allowing the crew to readily plot position visually, to check a descent instruction and confirm it is safe to descend to the given altitude; thus keeping control of the descent profile on the flight deck. Yet again, the BA Aerad team developed it. An old example for Zurich airport is illustrated below.

Had such a chart been available in the Barcelona area many years ago, a Dan Air Comet 4 aircraft might not have crashed in the mountains to the North of the airport. The pilots accepted an instruction to descend, in the mistaken belief that the controller had them on radar and knew it was safe for them to descend to the given altitude, at the time ATC gave the instruction.

19.3.4 Overflying high terrain

*Basic MSA calculation:* MSA shown includes an additional minimum safe over flight increment of 1000 feet added to the spot height of the obstacle, for obstacles up to 5,000 feet high, or a 2,000 feet increment, for spot heights above 5,000 feet AMSL, depending upon the height of the terrain.

*For general application*: The Basic calculation applies. To wit, where the terrain or obstacle is 5,000 feet above Mean Sea Level (AMSL) or lower, the MSA is 1,000 feet above, the highest terrain or obstacle within 20 nm of the route centre line. Where the terrain or obstacle is higher than 5,000 feet AMSL, the MSA is 2,000 feet or more above the highest terrain or obstacle within 20 nm of the route centreline.

*For flight in Controlled Airspace*: Where the Track is well defined by two separate aids, the MSA is 1,000 feet above the highest terrain or obstacle within 10 nm of the route centre line. Where the highest terrain or obstacle within 10 nm of the route centre line is higher than 5,000 feet AMSL, the MSA is 2,000 feet or more above that terrain or obstacle. When the sector length between navigational aids is such that the aircraft could be more than five nautical miles from the centre line due to inherent errors in the system used to define an airway, the limit of protection must be increased by the extent to which the divergence exceeds 5 nm.

*For radar controlled flights within 25 nm of the aerodrome of departure or intended landing:* The MSA is 1,000 feet above the highest terrain or obstacle within 5 nm of the intended track. Commanders are instructed to monitor all radar instructions by reference to other aids and are reminded that, when under radar control, it is their individual responsibility to ensure adequate terrain clearance. MSA within 25 nm of aerodromes are referred to as *Minimum Sector Altitudes*.

*The use of Flight Guides:* An operator may use MSAs and Minimum Sector Altitudes in a recognised Flight Guide, provided that the basis of the publisher's calculations will give at least an equal standard to that required by this section. If necessary, corrections can be made and promulgated in the Operations Manual, so that the prescribed vertical separation is maintained.

19.3.5 Corrections to planned MSAs for flights over high ground

When the selected cruising altitude, or flight level, or one-engine-inoperative stabilising altitude is at or close to the calculated minimum safe altitude and the flight is within 20 nm of terrain with a maximum elevation exceeding 2000 feet, any previously calculated **MSA must be increased** as follows:

| HEIGHT INCREASE FOR FLIGHT OVER HIGH GROUND | | | | |
|---|---|---|---|---|
| Elevation of terrain | Wind speed in Knots | | | |
| | 0-30 | 31-50 | 51-70 | Over 70 |
| 2000-8000 ft | 500 ft | 1,000 ft | 1,500 ft | 2,000 ft |
| Above 8000 ft | 1,000 ft | 1,500 ft | 2,000 ft | 2,500 ft |

Operations Manuals must include a reference to the effect of mountain waves on the maintenance of vertical separation, instructing commanders to take suitable precautions when such conditions are reported or forecast. Relevant instructions must be included in the Manual.

Adequate allowances to calculated minimum safe altitudes must be made when the ambient temperature on the surface is much lower than that predicted by the standard atmosphere. When the ambient temperature is lower than International Standard Atmosphere (ISA) -15°C, the following additions to minimum safe altitude must be made:

| | |
|---|---|
| Lower than ISA - 15°C | Not less than 10% |
| Lower than ISA - 30°C | Not less than 20% |
| Lower than ISA - 50°C | Not less than 25% |

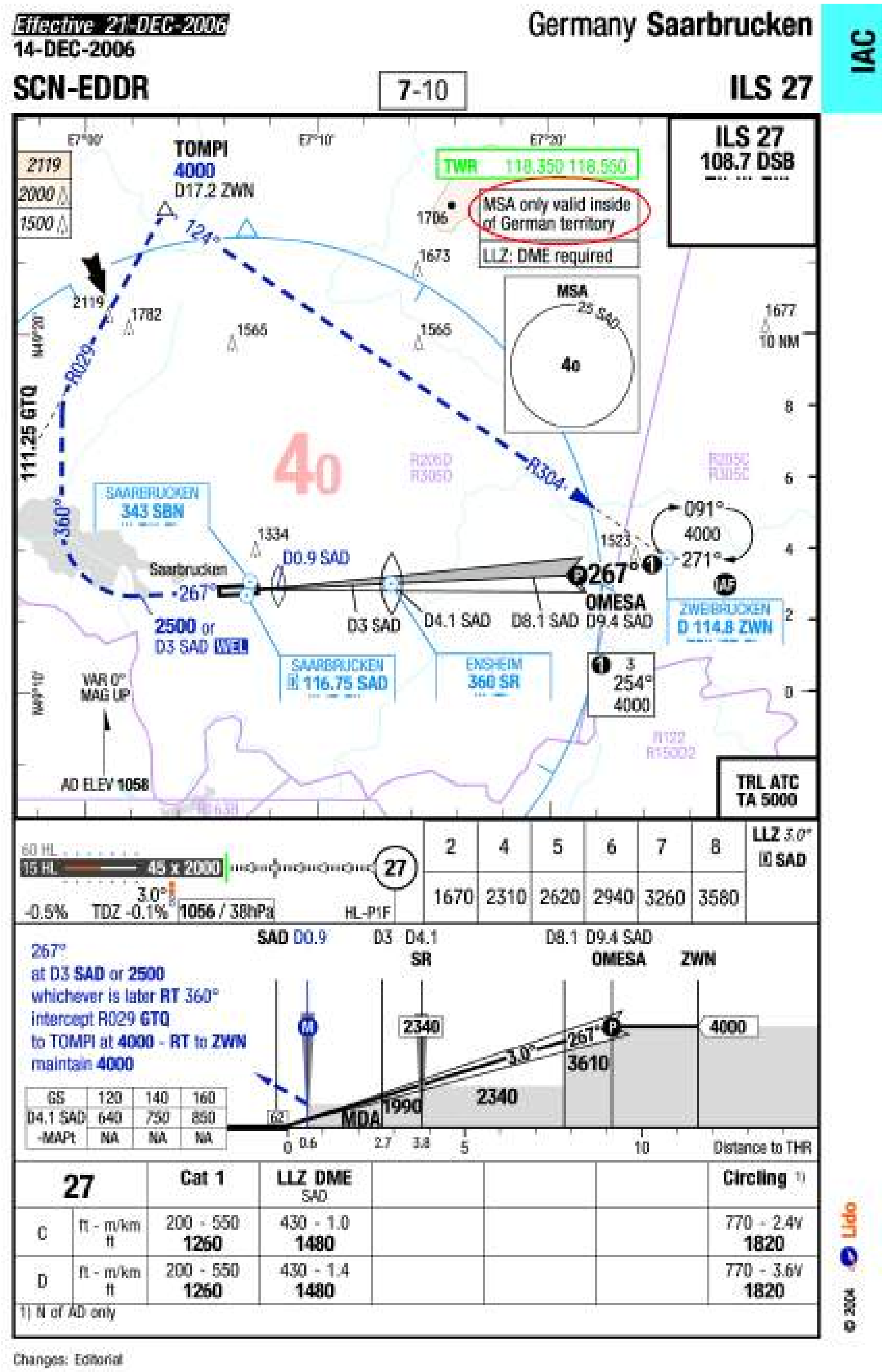
**Note: For any route, the maximum altitude obtainable with all power units operating, or the appropriate stabilising altitude with one or more engines inoperative must be greater than the calculated minimum safe altitude (MSA) for that route**.

**Antonov An-225** - Wikimedia Commons

## 19.4 ILLUSTRATIONS

19.4.1 A local German airport as example for limited MSA sectors

NOT FOR OPERATIONAL USE




| 2 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|
| 1670 | 2310 | 2620 | 2940 | 3260 | 3580 |

| GS | 120 | 140 | 160 |
|---|---|---|---|
| D4.1 SAD | 640 | 750 | 850 |
| -MAPt | NA | NA | NA |

| 27 | | Cat 1 | LLZ DME SAD | | | | Circling 1) |
|---|---|---|---|---|---|---|---|
| C | ft - m/km<br>ft | 200 - 550<br>1260 | 430 - 1.0<br>1480 | | | | 770 - 2.4V<br>1820 |
| D | ft - m/km<br>ft | 200 - 550<br>1260 | 430 - 1.4<br>1480 | | | | 770 - 3.6V<br>1820 |

1) N of AD only

© 2004 Lido

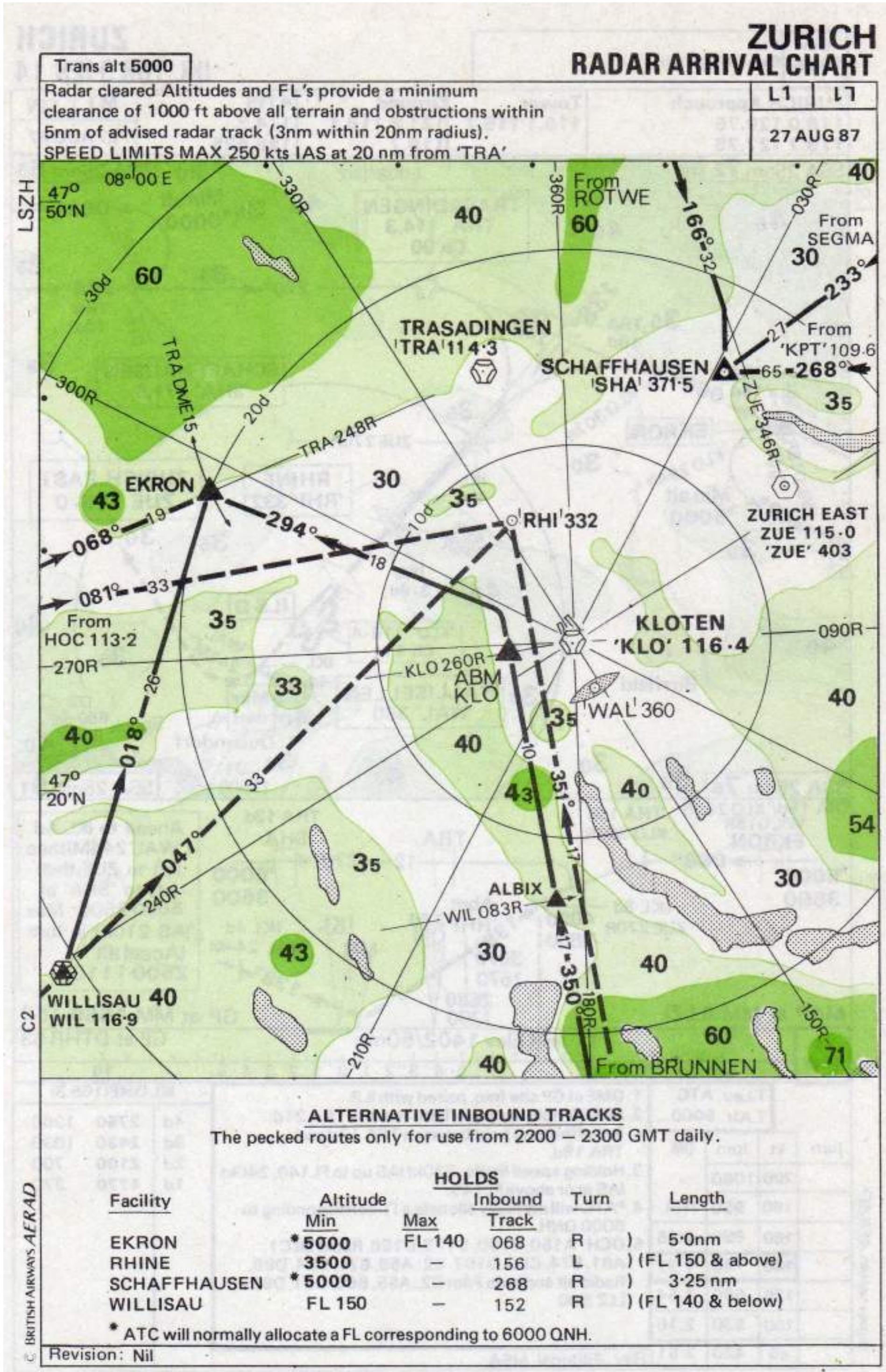
TUIfly (HapagLloyd)

With thanks to Lufthansa Systems AG, Marketing Communications, Am Weiher 24, 65451 Kelsterbach, Germany, Tel. +49 (0)69-696 90000, Fax +49 (0)69-696 95959,

As mentioned on the chart, the MSA sector is not 25 nm but is limited by the boundary of the territory, which makes it sometimes very hard to determine.

19.4.2 EAG Aerad Terminal area Radar Arrival Chart with DME Dartboard & MSA Contour envelopes

**NOT FOR OPERATIONAL USE**



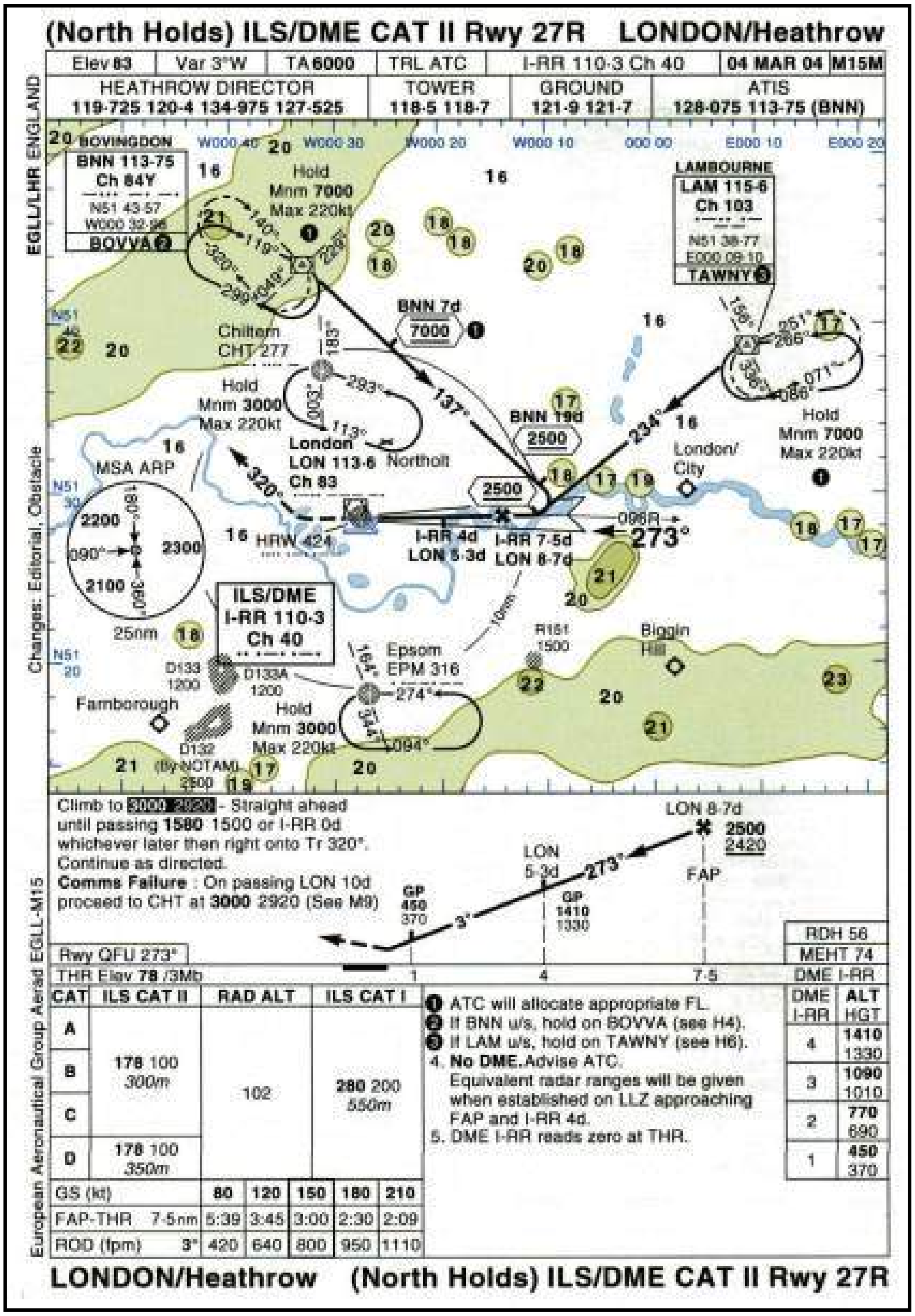

The aircraft position (distance and bearing from the Kloten VOR) can be readily ascertained whilst approaching Zurich, by looking at the 10 nm grid of concentric circles radiating from the VOR and the quadrant radials shown every 20°.

A clearance to descend can therefore be easily checked, to confirm that the MSA is such as to permit safe flight at the cleared altitude in the approaching area. The darker the green tint, the higher the MSA (which is shown as a two-figure group within the coloured contour).

MSA shown includes an additional minimum safe overflight increment of 1000 feet added to the spot height of the obstacle, for obstacles up to 5000 feet high, or a 2000 feet increment for spot heights above 5000 feet AMSL, depending upon the height of the terrain.

19.4.3 EAG Aerad - Instrument Approach chart wit h MSA contour envelopes

NOT FOR OPERATIONAL USE




The darker the green tint, the higher the MSA, which is shown as a two figure group within the coloured contour. The larger digit indicates a safe altitude in thousands of feet (on the QNH altimeter setting, that is above Mean Sea Level) and the smaller appended number giving the hundreds of feet; for example, 23 (means 2,300 feet AMSL). The Minimum Sector Altitude and MSAs shown, include pre-calculated minimum safe overflight tolerances of 1000 or 2000 feet, depending upon the height of the terrain.

The 25 nm range Minimum Sector Altitude is given in the circle printed, in this case, on the left hand side of the let-down plate above, showing it to be 2,200 feet to the North-West, 2,100 feet in the South-West and 2300 feet to the East of the 180°/ 360°delineator.

## 19.5 DRIFT- DOWN TO A STABILISING ALTITUDE AFTER ENGINE FAILURE

With thanks to SFO Peter Kohn (BA LHR - A320 fleet)

### 19.5.1 Introduction to the problem

In the event of an engine failure in the cruise, the aircraft may too heavy to be able to maintain the cruise Flight Level even with continuous thrust set. It will commence a drift-down to a levelling-off altitude which may be BELOW MSA for the route sector ahead. .

Data presented by the aircraft computer and / or extracted from the QRH includes target drift-down speed, stabilising altitude, plus distance and time to get there. These vary according to starting altitude, aircraft weight, ISA deviation and air bleed demands from packs and ant-ice. Wind component must be considered, to translate this into a ground distance. Engine-out predictions calculated by on board flight computers (FMC on Boeing / FMGC on Airbus), will incorporate all of these factors. Fight crew drift down tables or graphs in the performance manual (often repeated in the QRH for rapid access) will usually require reference to a separate chart to incorporate wind component and convert air distance to ground distance.

Graphs are easier to interpret readily but not all manufacturers subscribe to that point of view. Some produce tables instead. Examples of both presentations are offered below for your consideration.

### 19.5.2 Initial Actions

1. Fly the aircraft**.**

Set power on the remaining live engine to Maximum Continuous Thrust (MCT).

Re-trim the rudder to fly straight. Some aircraft (e.g. Airbus) will auto-trim to maintain balanced flight so negating the need to disconnect and trim the rudder manually. However if disconnecting the auto pilot is required, or has occurred due to aircraft system failures, do be aware that rudder is extremely powerful at high TAS.

Allow the speed to decrease to the drift-down value displayed in the FMC / FMGC CRUISE page, or as extracted from the QRH and then maintain it. On Airbus aircraft, this speed is permanently displayed on the ASI speed ‘tape’ as a green dot. Regardless of where or how it is displayed for your type, the aerodynamic significance of this speed is that it gives the highest Lift / Drag ratio. Therefore it is also the optimum speed to fly for best glide range in the event of loss of ALL engines.

In this configuration (MCT & recommended speed) the drift down will provide maximum range and minimum fuel burn.

2. Deal with the failure:

Initiate the appropriate checklist for the failure condition. It may be that a vibrating engine may run smoothly when throttled back. Even though you must consider it failed for performance purposes, you may wish to keep it running to maintain its ancillary services and systems redundancy. Carry out the checklist using the aircraft electronic checklist or appropriate Quick Reference Manual/Handbook (QRM/QRH), as dictated by your SOP.

In reality these initial actions will run in parallel: The aircraft’s deceleration towards target descent speed at MCT might take a minute or so, providing time to identify the failure as a crew and to initiate the abnormal drill from the second pilot.

E.g. A short-haul Airbus at typical weights takes around 90 seconds to reduce to drift down speed and then will descend at an initial ROD of around 300 fpm. This should provide ample time for the crew to apply correct, methodical initial actions, initiate any drills associated with the failure and to make a radio call. The subsequent descent rate is not necessarily an alarming one.

### 19.5.3 Subsequent considerations.

After the initial actions to keep the aircraft flying (vertical profile) and to initiate any abnormal drills required, the problem becomes one of which way to point the aircraft (lateral profile).

a. Obstacle Strategy (Terrain-Critical: Drift-down to maximum possible stabilising altitude)

If stabilising altitude is below the MSA, then assess the time and/or distance needed to drift-down stabilising altitude. Is it safe to continue or is a turn back is required?

Figure 19.5.4 shows how altitude lost per track mile is not a linear relationship: The initial rate of descent will be higher than the final one, which will reduce until it eventually reaches zero as the curve flattens out at the stabilising altitude. In reality we never get a type specific representation of this curve. We only know that that our aircraft’s profile will be of the same basic *form* as this curve; which is steeper initially and flatter at the end.

If predicted altitude at distances A and B (or any other) from present aircraft position can not be extracted because a type specific curve is not available, one might conclude that the curve is of academic interest only, but there is a real-world compromise. For example, in a heavy Airbus A320, the QRH data tells us that it takes 60 minutes and 330 Nautical miles to drift from FL350 down to FL195. If we were to assume a linear relationship (which we know it is not), then this would equate to an average ROD of circa 270 fpm. We know that the initial rate will in fact be higher than this, as corroborated by the 300 fpm figure value referred to earlier and which was achieved in a simulator. Conversely, the final ROD will be far less than 270 fpm, indeed miniscule as we get closer to our stabilising altitude. Take advantage of simulator practice on your aircraft type in order to know the performance you can expect if the worst happens.

What implications does all of this have for your decision as to where to point the aircraft? Although you do not know how steep the curve illustrated in 19.5.4 is for your aircraft on the day, you should (based on the above) have an idea of what ROD to expect. Your proximity to terrain may dictate that you make an immediate decision based upon these. However you will in all probability also have time to see what descent rate your aircraft actually settles at before making/confirming your decision.

Ideally you have already made your decision before the failure occurs. Imagine an engine failure approaching the Alps with an MSA of 18,300 ft in the above example and you expect to be at FL195 after another 330 n.miles. Although this predicted level off is uncomfortably close to MSA, you might justify continuing if the failure occurs very close to Mont Blanc because you know that in reality you will be nearly 330nm past the high ground of the Alps before you actually reached that altitude. Conversely if Mont Blanc was 330nm ahead of you when your engine failed, would you really want to continue? (Ignoring for a moment the twin engine requirement to divert and land as soon as practicable, as discussed earlier).

On your aircraft type, would your decision to continue change if a second engine failure occurred? To that end, what is the likelihood of a second engine failure, given what is known about the first one? Was it clearly limited to that engine (e.g. fire, catastrophic failure or shut-down due to high vibration)? Could your remaining engine(s) be affected (say by a volcanic ash encounter, icing or a fuel contamination / starvation / leak)? Perhaps the engine ran down for no discernible reason (computerised engine control or electro-magnetic interference)? Each scenario may subtly influence your decision whether or not to continue across the high ground. You might simply conclude that you always prefer to divert to an airfield (if one is available) on your side of the high ground, unless you are very close to, or directly above the highest peak at the moment of failure, and the terrain beyond it is known to fall away rapidly thereafter.

Some operators formalise the decision making process into pre-defined ‘escape routes’ for high MSA sectors above a certain aircraft weight. In the event of any engine failure a pre-determined route is flown which varies according to which stretch of the mountainous area is being over flown when the engine fails. Clearly it is imperative that the pilots know precisely which segment they are in at all times, so that the correct ‘escape’ is flown. Such escape routes are not just for twin engine aircraft: Multi engine aircraft like the B747 have escape routes in case they should lose two engines when routing across, (for example), the Himalayas when heavy.

On a multi engine aircraft the loss of one engine does not necessarily necessitate a diversion. On a twin engine aircraft you will be seeking to land as soon as is practicable / at the nearest suitable airfield. The important thing is that you DO have a plan and that your crew have one too. As Captain of a long haul aircraft you may well be asleep in your bunk when that engine fails, leaving the decision and initial actions in the hands of your capable co-pilots!

b. Standard Strategy (non Terrain-Critical: Normal descent to engine out Long Range Cruise altitude)

If the stabilising altitude is above MSA for the remainder of the route, then it is safe to continue for terrain clearance purposes, although the aforementioned considerations may still dictate whether or not you actually choose to continue.

The Obstacle Strategy uses large tracts of upper airspace and makes increased demands on the crew due to the very low rate of descent. Your own diversion requirements, or those of ATC, may dictate a more expeditious descent rather than a drift down. Hence, if terrain is not critical, then starting with the obstacle strategy buys time to get an ATC descent clearance; but thereafter, a normal descent rate and speed at idle thrust can be flown to your desired altitude for diversion, or whilst continuing along your route.

You may still need (for terrain clearance) to descend to the same altitude as would have been achieved using the obstacle strategy. If so, remember that you will end up slightly lower, since you will arrived there sooner hence heavier than in the drift down case.

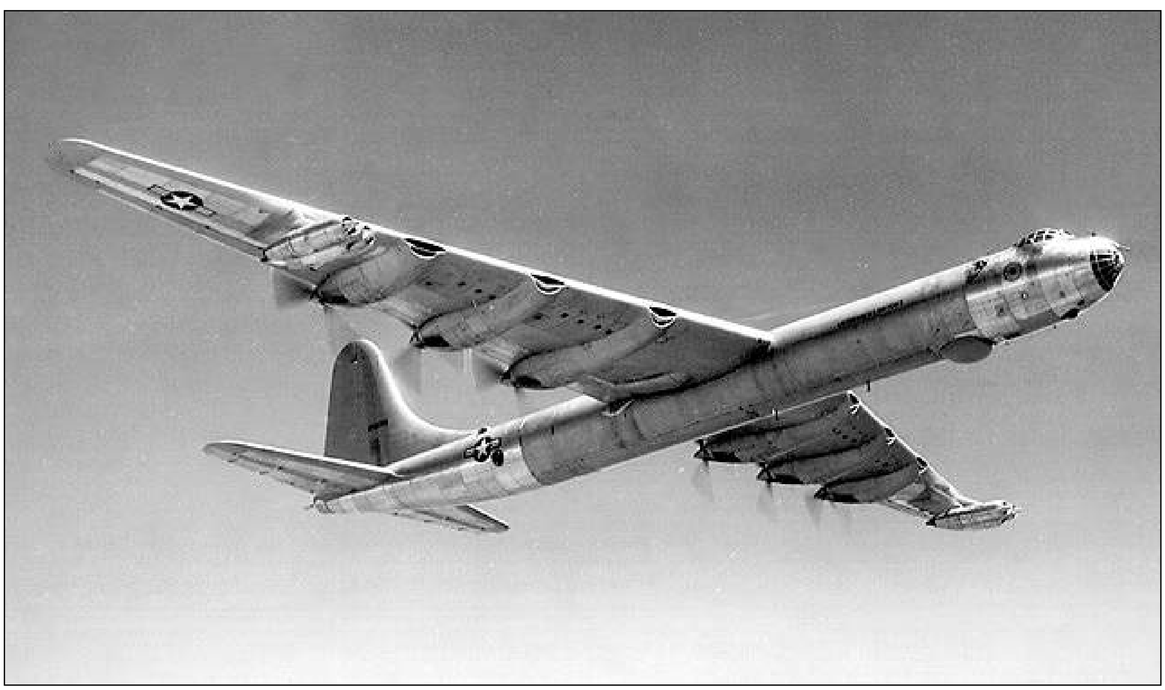
This stabilising altitude is a ‘maximum possible’ and initially requires MCT (later reducing with aircraft weight). Therefore in order to reduce strain on the engine (MSA, fuel and range permitting) it may be preferable to descend to a Long Range Cruise (LRC) altitude several thousands of feet lower than maximum. Therefore when / if you have no requirement to maintain the maximum stabilising altitude, descend to your chosen LRC altitude using normal descent speed and ROD, with idle thrust then resume level flight at LRC power setting and speed for the aircraft weight. Maintain these to the diversion or destination.

To conclude, it is essential to plan ahead when approaching high terrain such as the Alps, to establish the **WHAT/F** scenario should an engine fail (see earlier text on MSAs), fly the Obstacle Strategy initially, then convert to Standard Strategy when able (which may be immediately). Establish a stabilising altitude and the distance that will be covered whilst drifting down to it. Compare these with the worst MSA ahead of you and your distance from it. This allows a considered decision on whether to turn back before the mountain range is reached for a diversion on the ‘approach side’ of the high ground, if the aircraft is expected to reach stabilising altitude below the MSA for the sector. If it is safe, carry-on, fly over the high ground, then divert for a landing beyond it.

**Aneto range, Pyrenees** Wikimedia Commons – GNU FDL photo by Avh

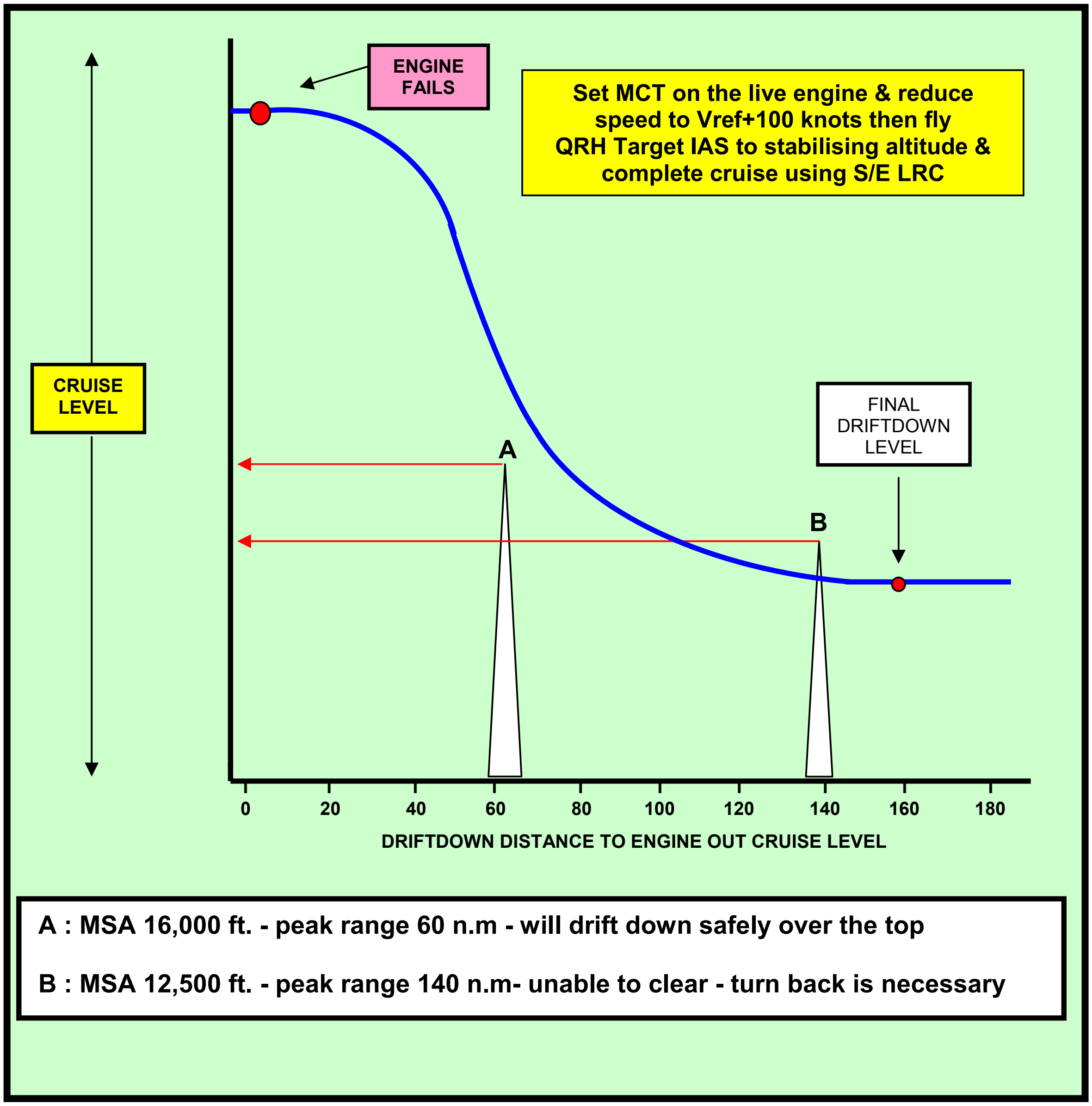
## To Cross or not to Cross?

**However many engines you may have …. Have you done your homework?**



**Convair B-36J ‘Peacemaker’, USAF** Wikimedia Commons / USAF PD photo

19.5.4 Illustrating drift-down profile to stabilising flight level / altitude




Graphic by Captain Christopher N Whiter FRAeS

This a general graph to illustrate an engine-out descent profile. Note the steep initial descent after the aircraft is held level initially to achieve the target drift-down speed. Note the gradual flattening-out of the descent path thereafter, as the aircraft approaches the stabilising altitude/ level-off height. Also note the calculated distance to it is, from where descent commenced after engine failure.

This example shows the implications of differing elevations within the same mountainous mass. Here the descent profile that started after engine failure is such that the first peak at A would be avoided, but not the next one at B, though lower in elevation. When flying over such a mountainous area, only the highest sector MSA should predicate the decision, notwithstanding that the distance to stabilising altitude might seem sufficient to avoid flying into a particular mountain.

MSA for whole the whole route ahead should inform your decision to turn back or carry-on ahead.

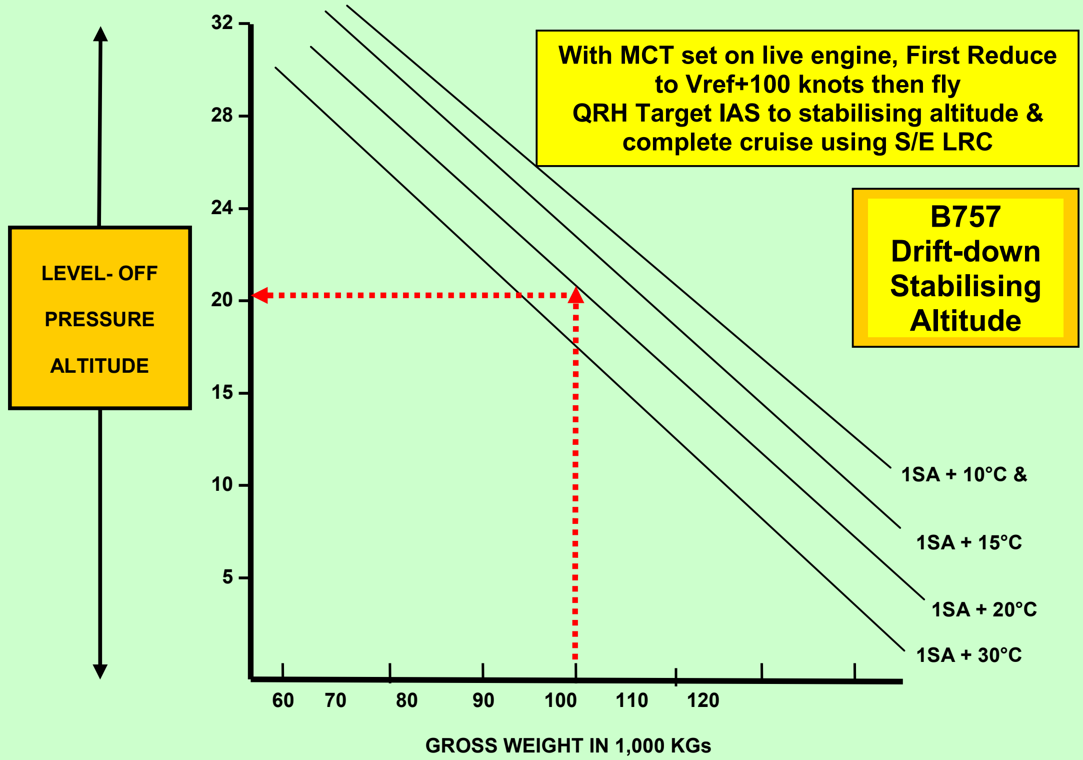
If there is any doubt, prudence requires a turn-back and an en-route diversion landing.

19.5.5. Example of Type-specific Drift-down Graph to establish Stabilising Altitude after engine failure

**(THIS GRAPH AND INSTRUCTIONS ARE SPECIFIC TO A TWIN-ENGINE B757 DRIFT-DOWN)**

***Sample presentation – not to be used operationally***

**Set Maximum Continuous Thrust (MCT) on live engine immediately**
(Then complete shut-down drill on failed engine & start APU when possible)




**NOTE: Based on 1 Bleed / 1 Pack on with APU OFF. For Alternate Bleed Configurations Make Corrections Shown in Table. For APU ON: Decrease Level-Off Altitude by 300 ft.**

| ALTITUDE CORRECTIONS FOR ENGINE BLEED | |
|---|---|
| PACK OFF | - 400 ft. |
| ENGINE ANTI-ICE ON | - 900 ft. |
| ENGINE & WING ANTI- ICE ON | - 3,400 ft. |

Boeing Graphic simplified & redrawn by Captain Christopher N White FRAeS

**FMS operation**: If an engine fails, use CON power on the operative engine. Apply 2 to 3 units of rudder trim. Manual rudder inputs should not be required but, if used, care must be used not to over-control as rudder is extremely powerful at high speeds. Select FMC CRZ page and allow speed to decrease to the value displayed. Upon reaching level flight the CMD SPD will change to Engine-out LRC (Long range cruise speed). Complete engine failure shut/down drills.

**FMC not available:** If FMC is not available, above FL200, CON power is available by advancing thrust lever fully forward. A drift-down speed of Vref + 100 should be used initially. When time permits, refer to QRH for the drift-down speed & altitude. Engine cruise data is available in the Performance Manual Part 2.

The example shows a stabilising altitude of just over 20,000 feet, on an ISA+20 day at a weight of 100,000 kilos at the onset of drift-down, with Maximum Continuous Thrust (MCT) set on the remaining live engine and the recommended drift-down Indicated Airspeed (IAS). The aircraft will level-off at an altitude which varies according to aircraft weight at the time. Note that the drift-down is not a straight line descent, but a curve which is steep to commence with but which flattens-out as the levelling altitude is approached, many miles ahead. (See the illustration of the typical engine-out descent profile in Figure 19.5.4).

**19.5.5** Example of Drift-down data presented in Tabular form

***Sample presentation – not to be used operationally***

**A320 ENGINE-OUT DRIFT- DOWN TABLE**
**(Set Maximum Continuous Thrust on live engine immediately)**

**Reduce to Vref+100 knots or FMC IAS then fly QRH Target IAS to stabilising altitude and complete cruise in SE/LRC**

**Net Drift-down – Corrections**

| | |
|---|---|
| Engine Anti-ice ON | Reduce table weights by 10,000 lbs. |
| Engine and Wing Anti-ice ON | Reduce table weights by 18,000 lbs. |
| A/C Packs OFF | Increase table weights by 5,000 lbs. |

**Net Drift-down – One-Engine Inoperative**

| TERRAIN ELEVATION (FEET) | MAX WEIGHT (Lbs) - A/C Packs On | | |
|---|---|---|---|
| | ISA & BELOW | ISA + 10°C | ISA + 20°C |
| 15,000 | 167,900 | 167,400 | 154,600 |
| 14,000 | 175,200 | 174,700 | 161,400 |
| 13,000 | 180,700 | 180,200 | 166,400 |
| 12,000 | 186,100 | 185,500 | 171,100 |
| 11,000 | 191,200 | 190,600 | 175,700 |
| 10,000 | 195,900 | 195,300 | 180,300 |
| 9,000 | 200,200 | 199,500 | 184,700 |
| 8,000 | 204,800 | 204,200 | 189,200 |
| 7,000 | 205,000 | 205,000 | 193,700 |

Airbus Graphic simplified & redrawn by Captain Christopher N White FRAeS

## SECTION 20 - STANDARD OPERATING PROCEDURES (SOP)

Airlines publish in-house instructions on how its aircraft are to be operated. These are known as Standard Operating Procedures (SOP).

SOP are published in the form of detailed instructions listing point by point, the necessary pre-flight, in-flight and post-flight duties/activities or aircraft checks that each individual crew-member is required to carry-out. Every pilot or engineer and cabin staff is trained to operate accordingly.

For example, every normal and abnormal operations/emergency checklist indicates the sequence of required actions, calls and responses at any particular time and who does what. All required actions for the operation of an aircraft are provided as expanded checklists that detail exactly what is required and who by. Individual duties are similarly addressed in the Company's Operations Manual. Ground Staff and aircrew are trained to operate to those commonality standards, which are developed by the airline for the safe operation of aeroplanes in its fleets. This provides a company-wide standard to be adopted by all. Conversion from one type of aircraft to another then becomes an exercise in learning the technicalities of the new aircraft type, whilst employing expected interpersonal and known operational procedures. However, some airlines have different SOPs for different fleets.

### 20.1 DEFINITIONS AND RESPONSIBILITIES:

The flight deck crew is made up of the Captain, a First Officer and Flight Engineer or P3, when carried. Duties are assigned to each according to carefully thought-out procedures and in the light of gained experience. In this manner everyone knows what is expected from each individual and of others whilst on flight operations, so that mistakes and errors can be more readily ascertained and corrected, before the situation deteriorates and accidents/incidents occur. The duties of each pilot are defined in greater detail in Part 2 *(Legal aspects of command*), at Section 3 - *Piloting Terms: A review of ICAO and JAA Source Material)* where the various terms used to refer to the pilots are discussed in detail.

It is common practice for pilots to share the flying and to therefore swop duties when one is to be the Pilot Flying (PF) and the other then becomes the supporting Pilot-not-flying (PNF) on a specific sector. It is interesting to note that Boeing has changed the wording from PNF to PM (Pilot Monitoring) to underscore the concept that the role of the other pilot is one of **actively** monitoring and not passively just “not flying” when not handling the aircraft.

20.1.1 Crew duties

Using the term Pilot Monitoring defines more clearly the co-pilot's role, when he is not handling the controls but acts in support of the Captain whenever the latter is the Pilot flying (PF). All 'Phase of flight duties' are then divided between the captain Pilot Flying (PF) and the first officer who is the Pilot Monitoring (PM).

Generally, each crewmember is responsible for moving the controls and switches in their given area of responsibility. *'Area of Responsibility'* illustrations and expanded instructions in Operations Manual instructions show the defined individual responsibilities, for both normal and non-normal procedures. Typical panel locations are shown and crew duties described in detail. Clearly, The Captain who is in overall command, may direct actions outside of the other crew-members' areas of pre-assigned responsibilities

SOPs will establish the general PF phase of flight responsibilities which are:
- taxiing
- flight path and airspeed control..
- airplane configuration
- navigation
- overall command and decision making

In addition, the mode control panel is the PF's responsibility. When flying manually, the PF directs the PM to make the changes on the mode control panel

SOPs will also detail the general PM phase of flight responsibilities which are:
- checklist reading
- communications
- tasks asked for by the PF
- monitoring taxiing, flight path, airspeed, airplane configuration and navigation.

PF and PM duties may change during a flight. For example, the captain could be the PF during taxi but be the PM during take-off through to landing. Notwithstanding, the captain is the final authority for all tasks directed and done.

Normal procedures show who does a particular step by 'crew position' (C, Co-pi/lot F/O, E, PF, or PM/PNF)
- in the procedure title, or
- in the far right column, *(see example hereunder of a B747 checklist for a 3 man crew),* or
- in the column heading of a table

**20.2 IMPORTANT NOTE**

Note that each Operator of a particular aircraft type will have a preferred SOP for managing approaches and other phases of flight, to ensure standardization across all their crews. A basic SOP could be broadly constructed as a skeleton for adoption by all fleets, to establish a Company Standard. Readers should recognize that company SOPs have primacy. The examples of crew procedures in this Guide should be seen as indicative rather than prescriptive, in essence. However, by adopting or adapting specific details of items or their sequencing from the examples offered as guidance, Fleet managers could refine their SOP accordingly, for best effect.

**A time when SOPs are of the essence ….**


**Unknown retouched photo** **MD 82 N454AA –photo: NTSB**

**… but if you want maintenance to trouble-shoot the problem … .**

**Deal with the event correctly and then bring back the aircraft in one piece!**

20.2 .1 A B-747 three-crew checklist showing required responses during engine start and who from

**C** = Captain, P = Co-pilot, **E =** Flight Engineer, G = Ground

The dotted line shows where reading may be paused whilst running the checklist

NOT FOR OPERATIONAL USE

**ENGINE START CHECKLIST**

| | | |
|---|---|---|
| Pre-Flight Check | Completed | ALL |
| Circuit Breakers | Set | E |
| INS/FMS | Nav Mode. Loading checked. Mix. | ALL |
| Oxygen Mask and Pres. | Checked | ALL |
| Window Heat | On | P |
| Probe Heat | Pitots Only (-136, PW COMBI); ON (-236) | P/E |
| Emergency Lights | Guard Closed, Lights Out | C |
| Flt. Cont. Switches | Guards closed, Lights out | C |
| Radios | Set/VORs manual | ALL |
| Servo Altimeters | QNH set and cross-checked | ALL |
| Fuel on Board | . . . Kg | C/E |
| ---------- | ---------- | ---------- |
| FMS | Updated | ALL |
| Take-off Data | Checked, indexed & bugged -136/-236/PW COMBI | ALL |
| Max. Airspeed Warning Switches (-236) | Set | ALL |
| Stabiliser Green Band Select S/W (-236) | Set, Lights out | C |
| Start Clearance (ATC) | Obtained | P |
| ---------- | ---------- | ---------- |
| Thrust & Start Levers | Closed and cut-off | C |
| Seats & Safety Harness | Locked & Secure | ALL |
| Doors | Status . . . . . | E |
| Beacon | On | P |
| Galley Power | Off | E |
| Boost Pumps | On | E |
| Ovrd/Jett Pumps (-236/PW COMBI) | As required | E |
| Pack Valves | All Off | E |
| Clear to Start | Obtained | P/G |
| Flight Recorder | On | E |
| Brake Pressure | Pump ON and Checked | E |
| ---------- | ---------- | ---------- |
| For Pushback only No.1 ADP or No.4 ADP | Auto | E |
| ---------- | ---------- | ---------- |
| Parking Brake & Press | Set and Checked | ALL |
| Start Pressure | Checked | E |
| Start Engines | 4, 1, 2 and 3 | E |
| ---------- | ---------- | ---------- |
| Start Levers | Idle | C |
| Stabiliser Trim | Checked & Set (-236 Lights Out) | C/P |
| Nacelle Anti-Ice | As required | C/E |
| APU Bleed Air Switch | Closed | E |
| Electrical Power | Lights Out, ess normal | E |
| Standby Power | Normal | E |
| Galley power | On | E |
| Air Cond | Set | E |
| Bleed Valves | Open | C/E |
| Hydraulics | Auto and Normal | E |
| Aft Cargo Heat | As required | E |
| Doors | Lights Out | E |
| Anti-Skid Ground Mode | Tested | E |
| TD Prot Off & Low Speed Bk Rel (If ftd) | Tested | E |
| Chocks & Grd. Equip | Removed | C |
| Dep. Time & U/C pins | GMT, u/c Pins Removed & Stowed | C |
| A.I.D.S. | Insert | E |
| APU | Stopped | E |
| Brake Pressure | Checked | ALL |
| Engine Start Check | Completed | P |

**The checklist covers required actions before and after starting engines.**
**These actions must be confirmed by using the checklist**
**However, starting the engines is done from memory**
**As used by British Airways on the 747 Classic Fleet circa 1980**

**SECTION 21 - ICAO GUIDANCE ON NOISE ABATEMENT) RULES**
Précis by Captain Tim Sindall FRAeS

***The following extracts from the ICAO document are quoted verbatim in their original presentation sequence and layout, with the original underlines and numbering system.***

**ICAO STATE LETTER – AN ABSTRACT ON**
**AMENDMENT 15 TO PANS-OPS 5TH EDITION VOLUME 1**

**Introduction**

On 1 December 2006, ICAO released a State Letter informing recipients that the President of the Council had approved Amendment 15 to the fifth edition of the *Procedures for Air Navigation Services – Aircraft Operations*, Volume 1 - *Flight Procedures* (PANS-OPS, Doc 8168) for applicability on 15 March 2007.

The nature and scope of the amendment to Volume I included updates to the procedures for the nomination of noise preferential runways and to introduce the authority of the pilot-in-command to refuse, for safety reasons, a runway offered for noise abatement purposes.

Whilst full details can be found in State Letter, reference AN 11/19-06/97, the text that follows quotes or summarises the amendments that address aircraft handling with reduced power (Section 3) and noise abatement procedures (Section 7).

Tasked by the Air Navigation Commission, the Operations Panel had in mind the need to clarify many of the former texts that appeared perplexing or ambiguous in meaning. The Panel sought, when amending Section 7 Chapter 2, to remove forever the possibility that flight crews would find themselves expected to accept a runway offered for noise abatement reasons when this would not be safe. The Panel had in mind the BAe 146 accident at Zurich (night, non-precision approach, low ceiling, poor visibility and a crosswind) when drafting the revised text.

**Reduced Power Take-off (Section 3, Chapter 1)**

Reduced power should not be required in adverse operating conditions such as:

1. If the runway surface conditions are adversely affected (e.g. by snow, slush, ice, water, mud, rubber, oil or other substances);
2. When the horizontal visibility is less than 1.9 km (1NM);
3. When the crosswind component, including gusts, exceeds 28 km/h (15 knots); and
4. When wind shear has been reported or forecast or when thunderstorms are expected to affect the approach or departure.

Noise Abatement Procedures (Section 7)

Noise Preferential Runways and Routes (Section 7, Chapter 2)

2.1.1 A runway for take-off or landing, appropriate to the operation, may be nominated for noise abatement purposes, the objective being to utilize whenever possible those runways that permit aeroplanes to avoid noise-sensitive areas during the initial departure and final approach phases of flight.

2.1.2 Runways should not be selected for noise abatement purposes for landing operations unless they are equipped with suitable glide path guidance, e.g. ILS, or a visual approach slope indicator system in visual meteorological conditions.

2.1.3 A pilot-in-command, prompted by safety concerns, can refuse a runway offered for noise preferential reasons.

2.1.4 Noise abatement shall not be a determining factor in runway nomination under the following circumstances:

1. If the runway surface conditions are adversely affected (e.g. by snow, slush, ice, water, mud, rubber, oil or other substances);
2. For landing in conditions:
   a. when the ceiling is lower than 150m (500 ft) above aerodrome elevation or the horizontal visibility is less than 1,900 m; or,
   b. when the approach requires vertical minima greater than 100 m (300 ft) above aerodrome elevation and:
      i) the ceiling is lower than 240 m (800 ft) above aerodrome elevation; or
      ii) the visibility is less than 3,000 m;
3. For take-off when the visibility is less than 1,900 m;
4. When wind shear has been reported or forecast or when thunderstorms are expected to affect the approach or departure;
5. When the crosswind component, including gusts, exceeds 28 km/h (15 knots) or the tailwind component, including gusts, exceeds 9 km/h (5 knots).

Aeroplane Operating Procedures (Section 7, Chapter 3)

3.1.1 This chapter provides guidance with regard to noise mitigating measures associated with the development and/or application of departure climb, approach, and landing procedures and the use of displaced runway thresholds.

3.1.2 The State in which the aerodrome is located is responsible for ensuring that aerodrome operators specify the location of noise sensitive areas and/or the location of noise monitors and their respective maximum allowable noise levels, if applicable. Aircraft operators are responsible for developing operating procedures in accordance with this chapter to meet the noise concerns of aerodrome operators. The approval of the aircraft operators' procedures by the State of the Operator will ensure that the safety criteria contained in 3.3 of this chapter are met.

3.1.3 The appendix to this chapter contains two examples of noise abatement departure climb procedures. One example is designed to alleviate noise close to the aerodrome, and the other is designed to alleviate noise more distant from the aerodrome.

Operational Limitations (Section 7, Chapter 3.2)

The pilot-in-command has the authority to decide not to execute a noise abatement departure procedure if conditions preclude the safe execution of the procedure.

Aeroplane operating procedures for the departure climb shall ensure that the safety of flight operations is maintained, while minimizing exposure to noise on the ground. The following requirements need to be satisfied:

1. All necessary obstacle data shall be made available to the operator together with the procedure design gradient to be observed.
2. Conduct of noise abatement climb procedures is secondary to meeting obstacle clearance requirements.
3. The power or thrust settings specified in the aircraft operating manual are to take account of the need for engine anti-icing when applicable.
4. The power or thrust settings to be used subsequent to the failure or shutdown of an engine, or any other apparent loss of performance, at any stage in the take-off or noise abatement climb, are at the discretion of the pilot-in-command, and noise abatement considerations no longer apply.
5. Noise abatement climb procedures are not to be required in conditions where wind shear warnings exist, or the presence of wind shear or downburst activity is suspected.
6. The maximum acceptable body angle specified for an aeroplane type shall not be exceeded.

Development of Procedures (Section 7, Chapter 3.3)

3.3.1 Noise abatement procedures shall be developed by the aircraft operator for each aeroplane type (with advice from the aeroplane manufacturer, as needed) and approved by the State of the Operator, complying at a minimum with the following safety criteria:

1. Initial power or thrust reductions shall not be executed below a height of 240 m (800 ft) above the aerodrome elevation.
2. The level of power or thrust for the flap/slat configuration, after power or thrust reduction, shall not be less than:
    a. For aeroplanes in which 'derated' take-off thrust and climb thrust are computed by the flight management system, the computed power/thrust; or,
    b. For other aeroplanes, normal climb power/thrust.

3.3.2 To minimize the impact on training while maintaining flexibility to address variations in the location of noise sensitive areas, the aeroplane operator shall develop no more than two noise abatement procedures for each aeroplane type. It is recommended that one procedure should provide noise benefits for areas close to the aerodrome, and the other for areas more distant from the aerodrome.

3.3.3 Any difference of power or thrust reduction initiation height for noise abatement purposes constitutes a new procedure.

Noise Abatement Departure Climb Guidance (Appendix to Chapter 3)

1.1 Aeroplane operating procedures for the departure climb shall ensure that the necessary safety of flight operations is maintained, while minimizing exposure to noise on the ground. The following two examples of operating procedures (*described in narrative and in pictorial format in the amended text contained in the State Letter*) have been developed as guidance and are considered safe when the criteria in 3.2 are satisfied. Each describes one method, but not the only method, for providing noise reduction for noise-sensitive areas (a) in close proximity to the departure end of the runway and (b) for areas more distant from the runway.

1.2 The two example procedures differ in that the acceleration segment for flap/slat retraction is initiated either prior to reaching the maximum prescribed height or at the maximum prescribed height.

**End of excerpt (see comments that follow)**

***Comments***

Paragraph 3.1.2 makes clear the separate but complementary responsibilities of the aerodrome operator and of the aircraft operator. Thus, the former must not tell the latter how to fly his aircraft.

Paragraphs 3.3.2 and 3.3.3 limit the complexity that could be faced by flight crew if more than two procedures were to be specified for use on the aircraft type they operate.

Paragraph 1.1 in the Appendix explains that the two methods described are only examples, and that operators should specify departure profiles that must be approved by their 'State of Registry' before use.

## SECTION 22 - HOLDING PATTERNS

by Captain C.N. White FRAeS

**ACKNOWLEDGEMENT**

My grateful thanks go to Captain Ralph Kohn FRAeS, friend and colleague, in that, without the wealth of his experience as a senior B747-400 flight inspector for The Civil Aviation Authority; the task would have been very onerous. His knowledge and legal mind have clarified many grey areas that have existed in aviation for so many years. His assistance and suggestions, which he offered whilst I was producing these words, have been invaluable.

Captain C.N. White FRAeS.

### 22.1 INTRODUCTION

**Although you are an experienced airman and clearly well versed in the art of 'Holding', this section might well offer a few tips that may be new to you, nonetheless.**

For those that do not have the benefit of an EFIS flight deck, reference to the relevant section will make the job easier and hence increase safety. Everything about holding patterns has been placed into this section (22) to make reference easier for the pilot. Sub-section 22.4.3 will also help to establish the correct entry procedure, when confronted with a holding pattern.

Entry into the hold, and the actual holding, cause pilots much worry and concern. This uses-up any spare capacity and reduces safety at a critical moment in the operation of an aircraft whilst in a congested area. The following notes are for assistance in determining the easiest way to achieve the correct hold entry, followed by an accurate hold in an aircraft.

The contents are orientated towards the jet, but the same limitations apply to non-jet aircraft, with some differences, depending upon local rules.

This guidance does not in any way supersede official publications.

### 22.2 THE STANDARD HOLDING PATTERN

The Standard holding pattern is a right hand hold, see (Figure 22-1) The Aircraft *HEADING,* **not** Aircraft track at the time of reaching the holding fix, determines the type of entry that is made. A ***Standard*** hold means turns to ***Starboard.*** Let '**S',** as the first letter of each word, link both words in your mind to remind you which way to turn, should you forget.

22.2.1 Turns

All turns are to be made at a bank angle of 25º or at a rate of 3º per second, whichever requires the lesser bank. The bank angle of 25º generally applies to jet aircraft. Light twins use 3º per second, a rate one turn.

22.2.2 Wind Allowance

All procedures shown on the diagrams depict **TRACKS** and pilots should attempt to maintain this track, by making allowance for known wind. This is achieved by applying corrections to both heading and timing during entry and while flying in the holding pattern. The minimum outbound time in strong tail winds is 30 seconds, for entry and hold. Time correction for head (+) or tail (-) wind components to remain within the protected area:

1. Add/subtract 1 second for each knot of wind component up to 50 knots.
2. Above 50 knots add/subtract an additional 1 second for each 2 knots of wind component over 50 knots.

   For example, with a Wind of 70 kts : -

   a. Up to 50 kts = 50 seconds.
   b. 50 to 70 kts = 20 ÷ 2 = 10 seconds.
   c. Total time = 60 seconds.
   d. If this is a tail wind, the minimum outbound timing is 30 seconds.
   e. If this is a head wind, then the outbound timing is 2 minutes (1 minute plus a further 60 seconds) if at or below 14,000 ft.

22.2.3 Instructions to Hold

Where a holding pattern is promulgated or illustrated, whether on an Airways chart or an Approach plate, ATC will say, "Hold at Brookman's Park". In which case the published inbound Track / Radial must be flown and turns made in the direction depicted by the illustration, after the appropriate "Entry."

The standard phraseology used by ATC when instructing an aircraft to hold elsewhere i.e. “En Route,” will be “Hold on the 030º Radial, Right turns.” This means fly inbound to the fix on the reciprocal track of 210º, then make a right turn on reaching the fix and take up the hold. It is now for the pilot to decide what type of entry is required.

ATC may require that the hold be flown on specifically timed legs at a given speed. Some holds will not be done on time but rather on a DME distance as shown in figure 22-2A.

In the following diagrams, by using the “HSI or RMI,” the pilot can visualise the hold and subsequently the entry required to take up that hold. (Figures 22-2A, 22-2B & 22-2C refer)

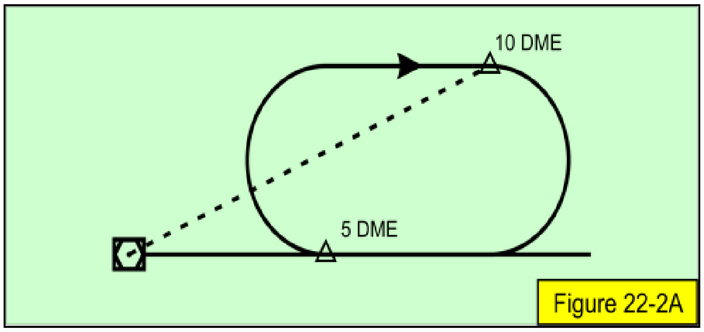


Figure 22-2A

22.2.4 Holding on Distance (illustrates a procedural ‘hold’ at 5 miles DME from station). [Figure 22-2A refers]

22.2.5 Standard Hold Entries
[Figures 22B & 22-2C together refer]

**MNEMONIC**

| | | | |
|---|---|---|---|
| **Sector 1** | ***P**arallel entry* | ***“P” Plan*** | |
| **Sector 2** | ***T**eardrop entry or Offset* | ***“T” The*** | ***= FUEL*** |
| **Sector 3** | ***D**irect entry* | ***“D” Diversion*** | |

When holding, think ***FUEL “Plan The Diversion.”***

**Figure 22-2B**

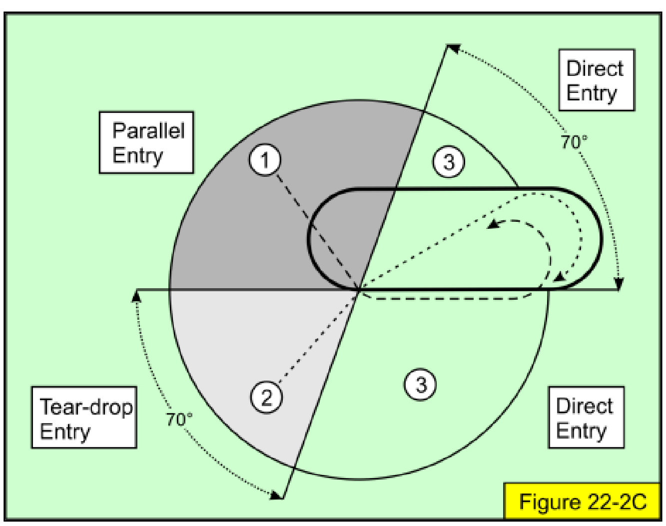


Figure 22-2C

22.2.6 Holding Speeds & Times

| Altitude / Flight Level | SPEED | TIME | TURBULENCE SPEED |
|---|---|---|---|
| Up to 14,000 ft. inclusive. | 230 kts. | 1 Min. | 280 kts. |
| (Cat A & B aircraft only.) | 170 kts. | 1 Min. | 170 kts. |
| Above 14 to 20,000 ft. inclusive. | 240 kts. | 1½ Min. | 280 kts. |
| Above 20 to 34,000 ft. inclusive. | 265 kts. | 1½ Min. | < of 280 kts. / 0.80 Mach |
| Above 34,000 ft. | 0.83 M. | 1½ Min. | 0.83 Mach |

Reduce to holding speed 3 minutes before reaching the holding fix, or at the "Speed Limit Point" (SLP).

22.2.7 Timing

Time refers to the outbound leg of the holding pattern (ICAO & UK, but NOT where FAA Rules apply in the USA and elsewhere). See notes, under "International Holding Pattern Timing" in 1.15.

Outbound timing begins over or abeam the fix (at 90° from inbound ***track***), whichever occurs later. If the abeam position cannot be determined, start timing when the turn to the outbound heading is completed.

Time must be factored for wind effect, to remain within the holding area. Add/subtract 1 second for each 1 knot of head or tail wind component up to 50 knots. Above 50 knots add/subtract an additional 1 second for every 2 knots of wind above 50 knots. The **minimum** outbound timing in strong tail winds is 30 seconds.

Permission must be obtained from ATC to hold at Turbulence speed. Additionally, permission must be granted to hold at a faster speed, if Icing conditions require specific minimum engine powers.

Longer outbound legs may be requested from ATC for extended holding. This usually occurs when Airway Holding, as the Terminal Area is too congested. It is more fuel efficient.

Where possible, jet aircraft to use 280 knots for holding procedures associated with airways route structures.

22.2.8 Holding Pattern Wind Correction

When wind is encountered in a holding pattern, the ground track is no longer is the ideal pattern as shown in Example "A" (Figure 22-2C) and the drift correction on the outbound leg is intercepted easily once the aircraft rolls out on the inbound course to the holding fix. The timing must also be adjusted on the outbound leg so that the inbound leg is 1 or 1.5 minutes, depending on altitude.

One of the basic rules of a holding pattern is that all turns must be made at a standard rate (not to exceed 30º of bank). For a given aircraft, this establishes the aircraft's radius of turn in free air, regardless if the aircraft is turning upwind or downwind. The ***ground track*** of the aircraft in a turn is affected by the wind, however as seen in Example "B" (Figure 22-2D), an aircraft turning upwind has a smaller round track radius of turn than when turning downwind. The turn downwind very often causes the aircraft to either overshoot or undershoot the inbound course, causing unnecessarily large corrections to the inbound course while close to the holding fix.

The aircraft may never become definitely 'established' on the inbound course prior to reaching the fix. One way to correct for this situation is to place the terminal point of the outbound leg either further from, or closer to inbound course (Example "C") depending on the direction of the crosswind. This is accomplished by using three times as big a drift correction on the outbound leg as on the inbound course, with a minimum of final course corrections.

The headwind component at holding altitude directly affects the timing of the inbound and outbound legs of the holding pattern. In order to compensate for the headwind component, the length of the outbound leg should be increased or decreased by the amount of time the inbound leg differs from one minute (1.5 minutes above 14,000 ft AMSL). This method offers the most effective way to adjust the inbound leg timing in the holding pattern.

22.2.9 Application of Drift

In order to achieve an accurate holding pattern staying within the "Safe Area" and to be able to establish quickly onto the inbound QDM, the following *drift* **must be applied**:

a. **Drift Allowance *up to* and *including* 14,000 feet : 1 Minute Holding Patterns.** (See Figure 22-E)
(Up to & including 14,000 feet, or Flight Level 140) : ***Treble*** the drift on the outbound leg.
E.g. If 3º of actual drift was applied' inbound' to the holding fix: apply 9º of drift.

b. **Drift Allowance *above* 14,000 feet : 1½ Minute Holding Patterns.** (See Figure 22-2F)
(Above 14,000 ft or Flight Level 140) : ***Double*** the drift on the outbound leg.
E.g. If 3º of actual drift was applied, inbound to the holding fix: apply 6º of drift.

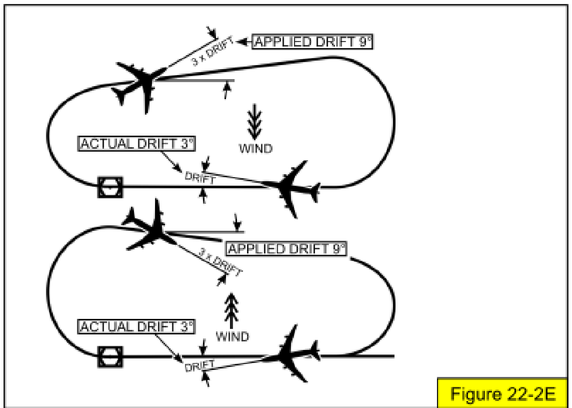



Figure 22-2E

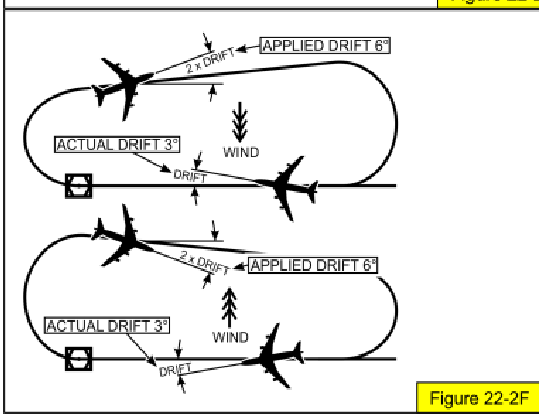



Figure 22-2F

2.2.10 Wind Effect on the Hold

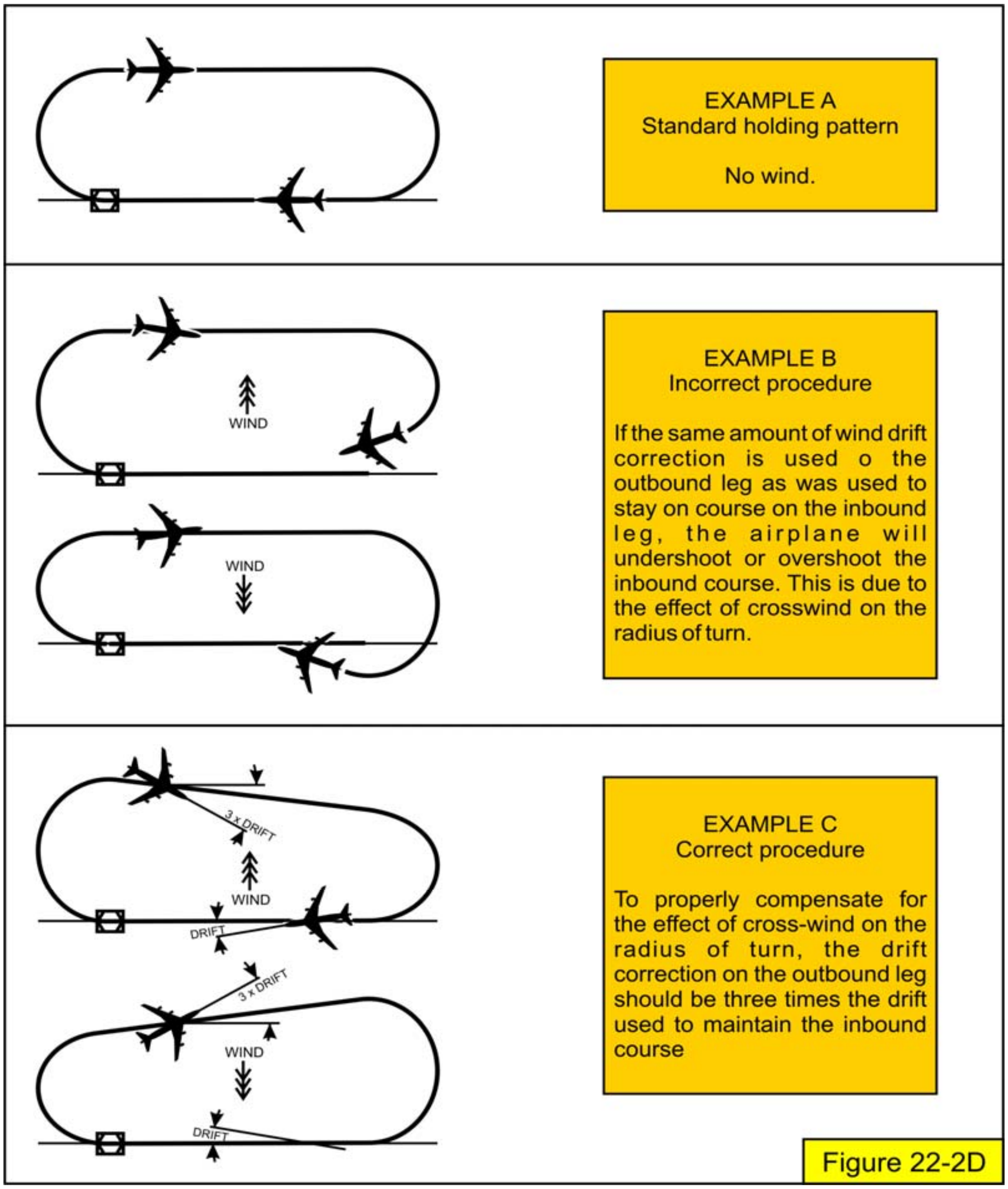

EXAMPLE A
Standard holding pattern
No wind.
WIND
WIND
EXAMPLE B
Incorrect procedure
If the same amount of wind drift correction is used o the outbound leg as was used to stay on course on the inbound leg, the airplane will undershoot or overshoot the inbound course. This is due to the effect of crosswind on the radius of turn.
3 x DRIFT
WIND
DRIFT
3 x DRIFT
WIND
DRIFT
EXAMPLE C
Correct procedure
To properly compensate for the effect of cross-wind on the radius of turn, the drift correction on the outbound leg should be three times the drift used to maintain the inbound course

Figure 22-2D

## 22.3 GENERAL NOTES

All procedures are promulgated in the State's AIP in descriptive format. These are the Legal requirements that must be adhered to. Approach and Let-down charts, whether published by the State or a generic provider such as Jeppesen, are ***not.*** Should a dispute arise and a Judicial Court become involved, the State AIP printed instructions relating to a particular procedure are the only legally useable reference. However, for all practical purposes, Charts provided are used by pilots as the primary source of information during a flight.

The UK AIP is CAP 032 (Also known as the UK Air Pilot). The UK AIP (together with AIP supplements. AICs and NOTAMS) is available on the internet from http://www.nats-uk.ead-it.com/public/index.php.html?

ICAO Document 8168 - PANS OPS CRITERIA is the original source of Requirements to be met internationally by signatory States to the ICAO Conventions.

a. Terms and Abbreviations

| | |
|---|---|
| Course | = American expression for Track. |
| Vat | = Speed at threshold, for a given flap setting. (English) |
| Vref | = Speed at threshold, for a given flap setting. (American) |

b Aircraft Categories

The latest ICAO Doc 6168 PANS-OPS Criteria as published in EU/OPS 1 & the UK AIP (With aircraft grouped according to their threshold speeds in knots)

| Aircraft Category | Vat V Ref | Range of speeds for initial approach | Range of Final Approach Speeds | Max speed for visual manoeuvring (Circling) | Max speeds for missed approach | |
|---|---|---|---|---|---|---|
| | | | | | Intermediate | Final |
| A | 91 | 090/150* | 70/100 | 100 | 100 | 110 |
| B | 91/120 | 120/180* | 85/130 | 135 | 130 | 150 |
| C | 121/140 | 160/240 | 115/160 | 180 | 160 | 140 |
| D | 141/165 | 185/250 | 130/185 | 205 | 185 | 265 |
| E | 166/210 | 185/250 | 155/230 | 240 | 230 | 275 |

Vat, Vref, (Threshold Speed) is based on 1.3 of the stall speed in the Landing configuration (landing gear down and full flap deployed), at Maximum Certificated Landing Weight.

* = Maximum Speed for Reversal and Racetrack Procedures:

a. CAT A = 110 kts.

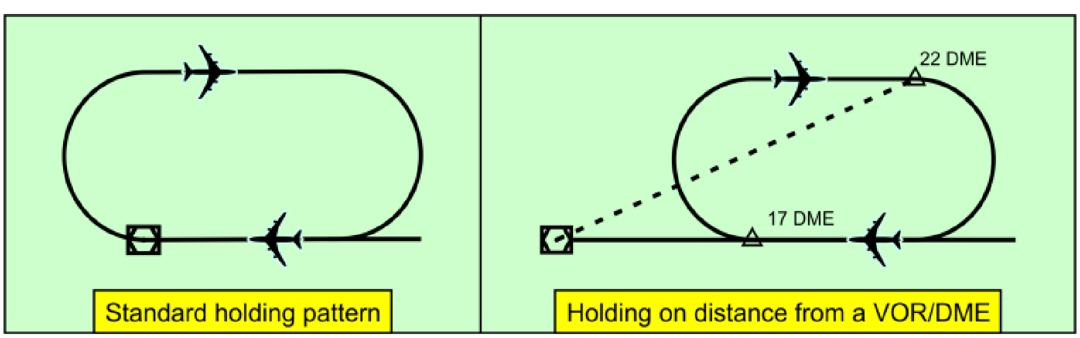
b. CAT B = 140 kts.

Where airspace requirements are critical, procedures may be restricted to either a lower speed category or a specified Maximum IAS.

22.3.1 International Holding Pattern Timing

a. FAA - Holding pattern leg length is measured on either the inbound or the outbound leg in the USA. When using “timing” the standard length, measured on the ***Inbound leg,*** is one minute at or below 14,000 feet’; and 1½ minutes above 14,000 feet. When using DME, the length is measured on the outbound leg. Outbound timing must be adjusted to achieve a 1-minute or 1½ minutes on the inbound leg.

b. ICAO - Holding pattern leg length is measured on the outbound leg. Standard length is the same as for the FAA - one minute at or below 14000’ and 1½ minutes above 14,000’, but applicable on the ***Outbound leg.*** Due to confined airspace in Europe, there are many holding patterns where the length of the outbound leg is determined by DME, not by timing. This is published on the chart or approach plate and is indicated in one of two ways - it is either shown as a DME notation (D17/22) meaning hold between 17 & 22 nautical miles on the DME, or by the addition of a second fix.



**Note:** The *'Smiths'* and the *'Honeywell'* FMCs do NOT build their DME racetracks based on the outbound leg, but base them on the inbound leg as per the FAA rule for holding! (Thanks for this tip to Capt Bill Bulfer, author of the "FMC User's Guide").

### 22.4 THE PRACTICAL APPROACH - FLYING HOLDING PATTERNS AND THEIR ENTRIES

22.4.1 How to Calculate Drift

A **jet aircraft** holding at 220 kts, with a wind at right angles, will have a maximum drift component of a ¼ of the wind speed. E.G. with a Wind Speed of 40 knots: 40 x ¼ = 10º of drift.

A light twin, such as a Seneca holding at 110 knots, with a wind at right angles, will have a maximum drift component of a ½ of the wind speed. E.g. with a Wind Speed of 40 knots: 40 x ½ = 20º of drift.

By using the RMI or HSI, this figure can be factored to calculate drift from other directions. The dotted line **B to A** and **B to Y** represent the maximum drift in figure 22-4A.

Decide where the wind is coming from and then draw a perpendicular to the line "**A to B"**, from the wind direction point on the HSI or RMI. The distance from **"B"** to the perpendicular point **"C"** is the proportional amount of drift on the current heading

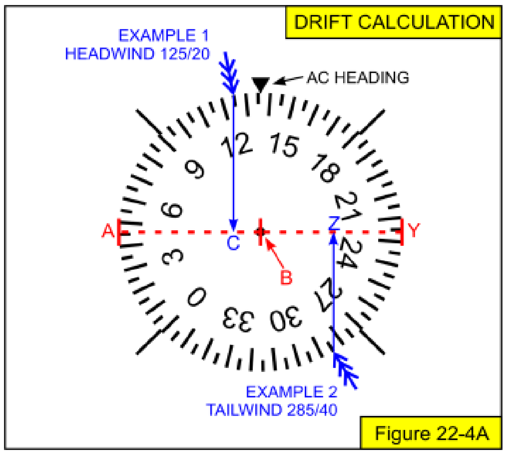


Figure 22-4A

**DRIFT CALCULATION (**Using Figure 22-4A)

**EXAMPLE 1** ***Jet Aircraft*** holding at 220 knots, Inbound Track 135º

**1.** Wind = 125º/20 kts
**A to B** = 20 x ¼ **= 5º Right, Maximum drift**
The wind is 10º off the inbound track
Point **C** 1/5 of the way along the **B to A** drift line
Total drift is 1/5 of 5º = 1º right drift.

**2.** Wind = 285/40
**Y to B** = 40 x ¼ **= 10º Left, Maximum drift.**
The wind is 30º off the inbound track
Point **Z** is 3/5 of the way along **the B to Z** drift line
Total drift is 3/5 of 10º = 6º left drift

**EXAMPLE 2** ***Light twin*** holding at 110 knots Inbound Track 135º.

**1.** Wind = 125º/20 kts
**A to B** = 20 x ½ **= 10º Right, Maximum drift**
The wind is 10º off the inbound track
Point **C** 1/5 of the way along the **B to A** drift line
Total drift is 1/5 of 10º = 2º right drift.

**2.** Wind = 285/40
**Y to B** = 40 x ½ **= 20º Left, Maximum drift.**
The wind is 30º off the inbound track
Point **Z** is 3/5 of the way along the **B to Z** drift line
Total drift is 3/5 of 20º = 12º left drift**.**

22.4.2 Holding Pattern Visualisation

**ICAO PANS-OPS Volume 2, Section 4, Chapter 1, Note 2, states:**

Note 2. — The criteria contained in this part are related to RIGHT TURNS holding patterns. If no operational considerations prevail, right turns holding patterns should be established. ATC will advise if they require a left hand pattern to be flown. For left turns holding patterns, the corresponding entry and holding procedures are symmetrical with respect to the inbound holding track.

This establishes right-handed holding patterns as the default. There is no reference in PANS or SARPS to Right-hand holds being 'standard'. Pilots are generally encouraged to avoid non-standard methods of operation whenever possible. So, to avoid introducing any encouragement in the use of any 'non-standard' procedures and to keep it simple, reference to *'Standard'* and *'non-standard'* holds should be avoided.

Figure 22-4B, shows how the holding pattern can be viewed on the RMI or the HSI. The holding fix (either a station or an intersection) lies in the centre of the compass card, with holding radials emanating from it. Both left and right hand holding patterns can be represented in this manner.

Holding patterns for specific procedures are shown on Navigation charts and Let-down plates. They may be right handed or left-handed. If asked by ATC to hold en-route whilst on 'Airways' or wherever, pilots must fly a right-hand turns pattern, using the centre line as the inbound track to maintain; at the radio aid or maybe at a given DME distance from the VOR ahead, or occasionally on a particular radial from it.

In this example, for ***RIGHT HAND*** holding patterns, as shown in holding pattern **"A"** (Figure 22-4B), the aircraft is instructed to hold northeast of the fix on the 030º radial. In order to visualise this, the pilot should place his index finger on the face of the compass card at the holding radial (030º) and move towards the centre of the card (the holding fix). From here, the pilot turns **RIGHT** from the holding radial to the outbound track and then back inbound, on the holding radial in a race-track pattern. This diagram depicts a Default Right-hand turns holding pattern procedure as it should be flown, once established in the hold. (The Holding-pattern 'Entry' alternatives are covered separately).

A similar procedure is followed when instructed to hold in a ***LEFT HAND*** pattern. In Holding-pattern **"B" (**Figure 22-4B), the aircraft is holding southeast of the station on the 120º radial, left turns. The index finger should be placed on the 120º radial, at the outer edge of the compass card and moved in to the holding fix at the centre of the card, then **LEFT** to the outbound track and then back inbound on the holding radial. This diagram depicts an established Left-turns Holding-pattern procedure. The wing-tip index are the points at 90º either side of the aircraft's heading (180º & 360º in Fig 22-4B)

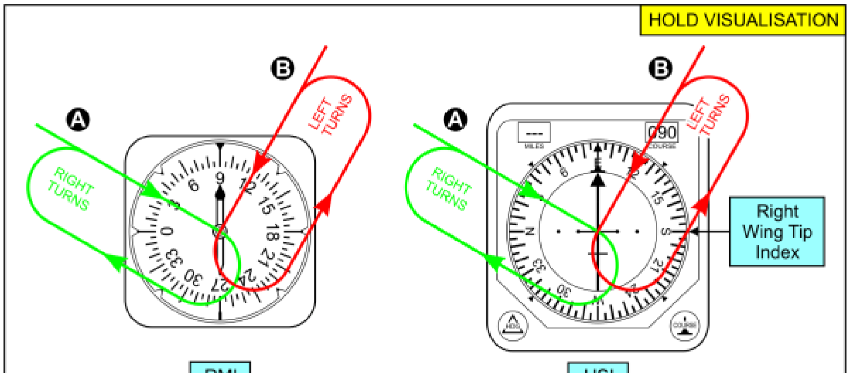


Figure 22-4B

22.4.3 Determining the required Entry to a Holding pattern

The RMI & HSI in Figure 22-4C depict the Holding Entry sectors for a right–hand turns hold, the 'Default' Holding pattern. These sectors are determined by placing the **RIGHT** thumb on the HSI or RMI, so that it covers 20º up from the right wingtip index. A straight line is then mentally drawn across the HSI or RMI from 20º above the right wing-tip index (160º) through the centre of the HSI or RMI 20º below the left wingtip index (340º). This line divides the teardrop and parallel entry sectors from the direct entry sector. A vertical line is drawn from the heading index to the centre of the compass card will separate the parallel and teardrop entry sectors. **Remember that for a RIGHT-HAND holding pattern as in this case, use your *RIGHT* thumb, whilst for a LEFT-HAND holding pattern, you use your LEFT thumb.**

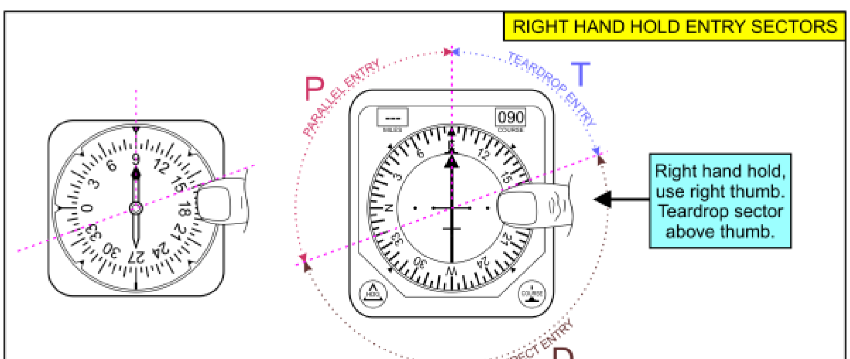


Figure 22-4C

By observing which sector the assigned holding radial lies in, the correct entry procedure can then be determined.

REMEMBER "You wipe the **TEARDROP** from your eye with your **THUMB"**,

OR … The **TEARDROP** entry segment is the ***TINY*** sector always on the side of and above where the **THUMB** is.

## 22.5 APPROACHING STANDARD HOLDING FIX AND THE APPROPRIATE ENTRY TO THE HOLD

### 22.5.1 Teardrop Entry

Figure 22-5A depicts the aircraft assigned to hold on the 130º radial and nearing the holding fix on a heading of 090º. The inbound holding course of 310º has been set prior to reaching the holding fix. Since the holding radial of 130º lies within the teardrop entry sector, an initial turn to the Right will be made onto a heading offset 30º from the outbound heading, towards the holding side (100º in this case).

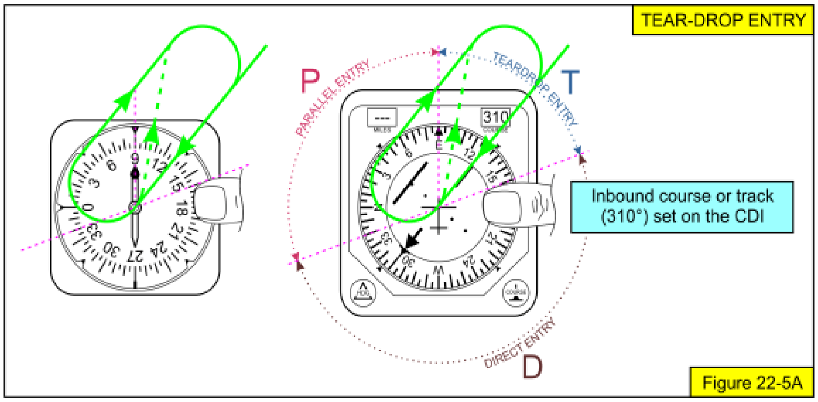


Figure 22-5A

### 22.5.2 Parallel Entry

Figure 22-5B depicts the aircraft assigned to hold on the 060º radial and nearing the holding fix on a 090º heading. The inbound holding course of 240º has been selected prior to reaching the holding fix. Since the holding radial of 060º lies within the parallel entry sector, an initial turn to the outbound heading of 060º will be made upon crossing the fix.

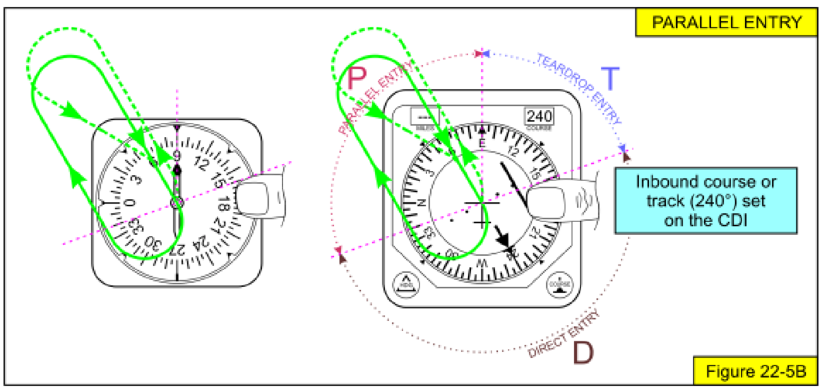


Figure 22-5B

### 22.5.3 Direct Entry

Figure 22-5C depicts the aircraft assigned to hold on the 310º radial and nearing the holding fix on a 090º heading. The inbound holding course of 130º has been set in prior to reaching the holding fix. Since the holding radial of 130º lies within the direct entry sector, an initial turn in the direction of holding (right hand) to a heading of 310º will be made, upon crossing the fix.

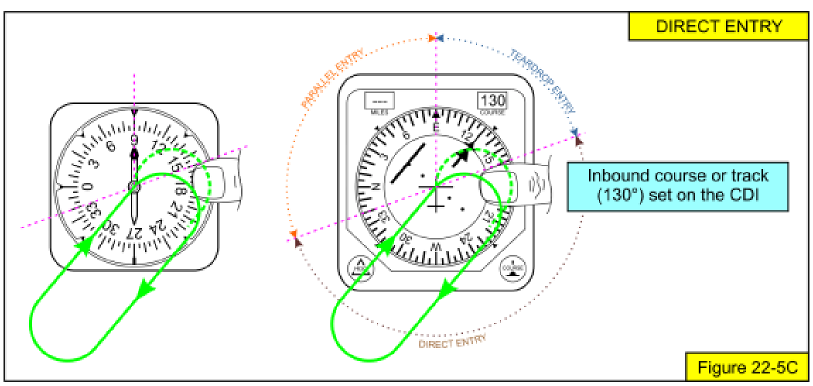


Figure 22-5C

22.5.4 Marginal Entry

Entry into a holding pattern is determined by the aircraft's ***HEADING*** not its track at the time of passing overhead the holding fix. If the Holding radial lies within the shaded areas, (that is the aircraft heading is within +/- 5º either side of an entry-sector separator-line bearing) when the aircraft crosses the holding fix, the pilot has the option of entering the hold using either one of the entries that straddle the shaded area. (Figure 22-5D gives two examples, one for an RMI hold inbound on 090º and the other for a VOR hold on the 060º radial)

Put in another way, if the aircraft approaches the holding point flying close to, or along, the line separating adjacent quadrants and provided the ***aircraft heading*** is within +/- 5º of the alignment of a particular segment separation line, the hold is entered using one of the entry procedures on either side.

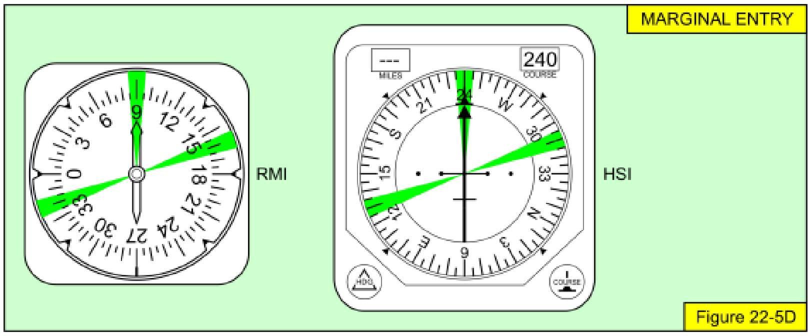


Figure 22-5D

22.5.5 Entry to a Left hand turns hold.

In Figure 22-5E, the RMI and HSI depict the holding entry sectors for a Left–hand turns Hold. These sectors are determined by placing the **LEFT** thumb on the HSI or RMI so that it covers 20º up from the left wingtip index. A straight line is then drawn mentally across the HSI or RMI from 20º above the left wingtip index (020º) through the centre of the HSI or RMI, to 20º below the right wingtip index (200º). This line divides the Teardrop and Parallel entry sectors from the Direct entry sectors. By observing which sector the assigned holding radial lies in, the correct entry procedure can be determined in the same fashion as was used for the 'default pattern' entry. It will of course be a mirror image. **Remember that for a *Left-hand* holding pattern, as in this case, use your *Left* thumb, whilst for a *Right-hand* holding pattern, use your *Right* thumb**. (See Figures 22-5A, 22-5B and 22-5C).

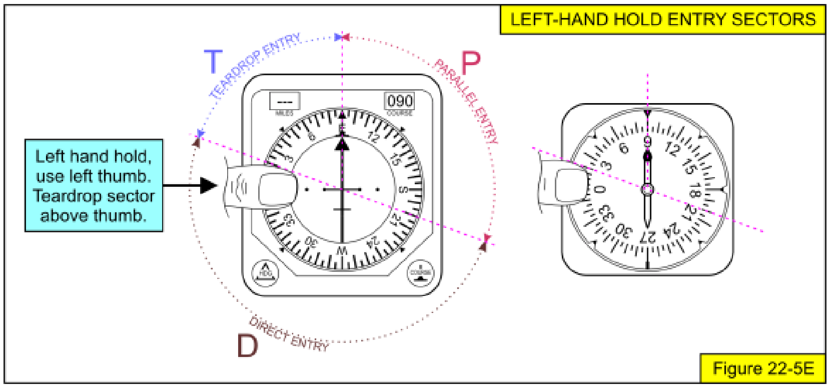


Figure 22-5E

22.5.6 Achieving the Required 'Holding' speed

ATC expect you to arrive at the holding fix at the correct speed for the Altitude or Flight Level flown.

Remember to commence your deceleration to the required holding speed three minutes before reaching the station. A quick method of estimating the time to the VOR / DME holding fix, is as follows:

TAS, in Nautical miles (nm) per minute, approximately equals the indicated Mach number. For example, a Mach No. of 0.60 is roughly 6 miles per minute. So if the aircraft is 72 nm from a VOR / DME station, the time to reach it is 12 minutes (72 ÷ 6 = 12 minutes). Work-out the distance as you approach the holding facility and then start you speed reduction at the appropriate distance. At 0.60M, this is 18 nm to the start of deceleration.

This quick way of working-out the time to a VOR / DME can also be used whilst on an long 'Airways' sector to estimate arrival time over the reporting point ahead, then comparing it to the Flight-plan ETA, thus monitoring progress and any loss or gain of time. ATC must be informed of differences of 3 minutes or more in an ETA to a reporting point.

**SECTION 23 – LET-DOWNS AND APPROACHES**
by Captain C.N. White FRAeS

## 23.1 THE LET DOWN

### 23.1.1 Preamble

By way of a "refresher", these course notes for pilots on a command course include lucid details of all the instruments and radio aids that they will be expected to use and how best to use them. However experienced the reader may consider himself to be, a good refresher does no harm and may even bring to the surface forgotten procedural subtleties that have been forgotten with the passage of time. New little memory jolters and 'Safety Bubbles' to confirm all vital actions are completed, could be usefully reintegrated into one's Modus Operandi as a result, to sharpen thinking and to make sure that said vital actions are not missed, notwithstanding use of the normal checklist; but in addition to it.

Please note that the refresher instructions have intentionally been made very comprehensive. They include clear indications on how to interpret the conveyed information so as to manoeuvre the aircraft accordingly. By so doing, the aircraft should arrive at a point in space in front of the runway upon which a landing is intended, ready to continue safely all the way to touch-down with flaps set to the required landing position, the undercarriage down and the speed exactly as calculated for the weight of the landing aircraft. Provided that the speed is 'on target', as the aircraft crosses the threshold whilst on the correct glide path, the landing can be completed in the available runway length without over-running the paved surface. Guidance given is offered to adopt or adapt and as a help to fine tune the quality level of your operation as a new captain.

This Specialist Document Section is written as a refresher on the art of instrument flying and instrument approaches, for pilots who may be new to an aircraft type on promotion to command and learning to carry out procedures and landings on their new airliner. It describes radio facilities to be used of precision and non-precision quality and explains every aspect of an approach, both visual and "on instruments", to demonstrate what are in effect parallel procedures to the touchdown point. The flying can either be manual or it can be controlled automatically.

This Section first makes the case for the safe "Stabilised, Continuous approach", where both azimuth and vertical path guidance are given to the pilot to follow to DH/DA. This allows the pilots to easily determine whether they are left or right of the centreline, or high or low on the glide path. This is called a Precision Approach.

Instrument approaches where azimuth information is pilot-interpreted (needle pointer, RMI, CDI or VDF type presentations) with no direct visual vertical guidance, are discussed. These are called a Non Precision Approach. The pilot must construct the vertical profile to MDA from information provided on the approach plate, to prepare his descent in a safe "Stabilised, Continuous approach" manner.

*This, in contrast to the dangerous and messy "Dive and Drive" procedure adopted by some operators, because ICAO permits it and Regulators allow it, for some well meaning but totally confused reason. However, its risks have meant that, generally in the Western airline world, dive and drive non-precision approaches are no longer used because of their inherent dangers. Manoeuvering below Circling Height on an 'Indirect approach' is prohibited by most major airlines.*

Simply, the safe "Stabilised, Continuous approach", should be flown whatever the approach.

## 23.2 LET DOWN PROCEDURES AND THE EQUIPMENT USED TO CARRY OUT APPROACHES

A number of precision and non-precision approach-to-land procedures are formally recognised and Approved by The International Civil Aviation Organisation (ICAO). These are for use by aeroplanes that have to carry out cloud break procedures and then land in all kinds of weather conditions, by day or by night. Approaches to land are generally carried-out using ground based electronic transmissions, that can be received and interpreted by the pilots, to achieve a position in space from which they can safely continue their descent to land on a given and suitably equipped runway.

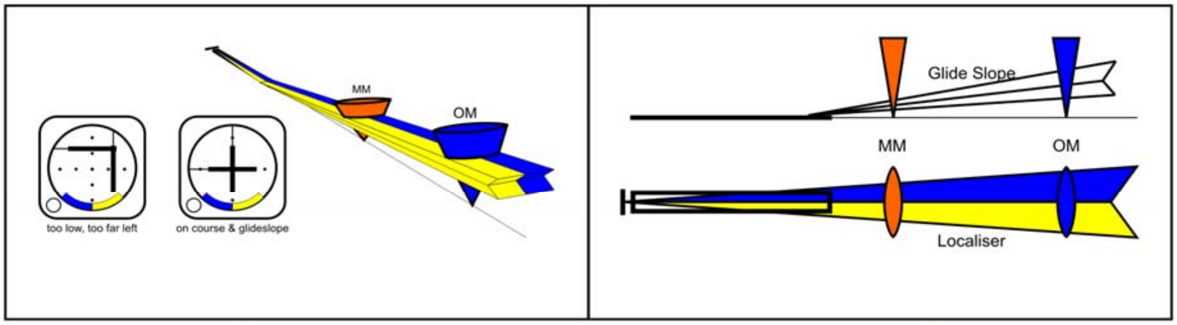
### 23.2.1 THE PRECISION APPROACH (ILS)

A precision approach provides indications of where an approaching aircraft is positioned in relation to two fixed radio transmission beams, one vertical and one horizontal. These give the pilot an idea of how close the aircraft he is flying is from each beam, by way of a receiver and instruments on the flight deck.

The vertical beam shows the extended centreline of the runway on which a landing is intended. It is called the Localiser and allows the pilot to track along it to the runway. Note that a one dot displacement indication away from the 'on-track' signal is equivalent to a displacement of 1¼ degrees from the centreline when on an ILS approach. At Full scale it is 2½ degrees (as against 5 degrees for each dot when tracking on a VOR signal); this on a Standard HSI presentation with only two dots, one at half, then one at full needle travel, to indicate angular displacement on either side of centre. Some other Course Deviation Indicators (CDI) presentations which have either VOR or ILS presentations as selected by the pilot may have either 3 or 5 dots to full scale deflection. (A 3-dot dial is illustrated below).

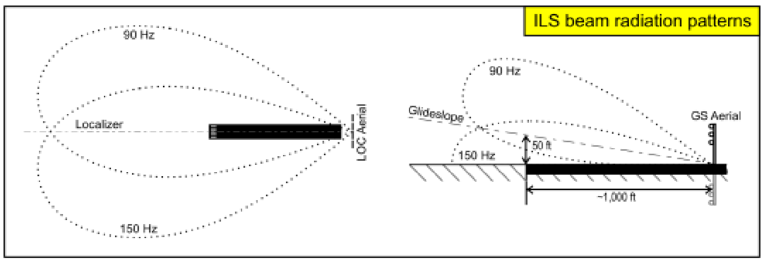
The second (horizontal) beam called the Glide Path, guides the aircraft down towards the runway aiming point at a predetermined fixed angle that may be slightly varied during the system installation, to provide a sloping descent path that on average gives an approach angle of 3°.

It is important to realise that a one dot displacement above or below the glide slope is not equidistant from the 'on-glidepath' indication. In layman's language, the actual height in feet above the glidepath is greater than that below it, for a one dot displacement. In the UK, vertical coverage is provided from 1.35° to 5.25° above the horizontal for a 3° glidepath, 8° either side of the localiser centreline, to a distance of 10 miles from the threshold.




ILS instruments with localiser and glideslope profile

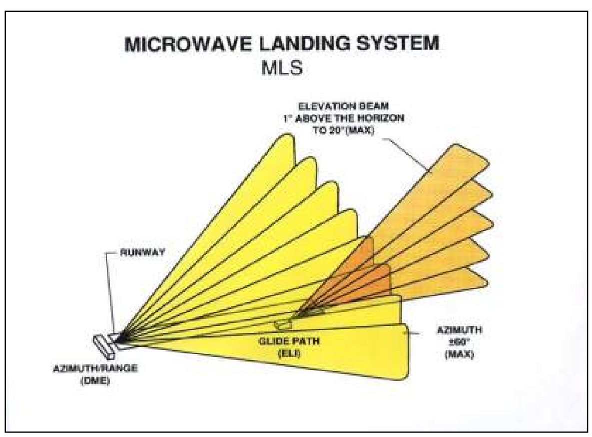
**ILS Beam Radiation Pattern**




**NOTE:** At modern airfields the Final Approach Fix (FAF) NDB, Outer Markers & other Markers are being replaced with a DME, calibrated to show distance to run to the threshold of the runway served by the ILS.

23.2.2 **MICROWAVE LANDING SYSTEM (MLS)**

The **Microwave Landing System** (MLS) is an all-weather, precision landing system originally intended to replace or supplement the Instrument Landing System (ILS). MLS has a number of operational advantages, including a wide selection of channels to avoid interference with other nearby airports, excellent performance in all weather, and a small "footprint" at the airports. The system allows inbound tracks to be selected as well the glidepath angle. The ILS can be readily switched to MLS by the pilot, for use at airports where it is installed. MLS uses the same flight deck instruments presentation as for ILS.




MLS employs 5GHz transmitters at the landing place which use passive electronically scanned arrays to send scanning beams towards approaching aircraft. An aircraft that enters the scanned volume uses a special receiver that calculates its position by measuring the arrival times of the beams.

Compared to the existing ILS system, MLS has significant advantages. The antennas are much smaller, due to using a higher frequency signal. They also do not have to be placed at a specific point at the airport, and can "offset" their signals electronically. This makes placement at the airports much simpler compared to the large ILS systems, which have to be placed at the ends of the runways and along the approach path.

Another advantage is that the MLS signals cover a very wide fan-shaped area off the end of the runway, allowing controllers to vector aircraft in from a variety of directions. In comparison, ILS requires the aircraft to fly down a single straight line, requiring controllers to distribute planes along that line. MLS allows aircraft to approach from whatever direction they are already flying in, as opposed to flying to a parking orbit before "capturing" the ILS signal. This is particularly interesting to larger airports, as it potentially allows the aircraft to be separated horizontally until much closer to the airport.

The system may be divided into five Operational Functions: Approach azimuth, Back azimuth, Approach elevation, and Range & Data communications.

**Approach azimuth guidance**

The azimuth station transmits MLS angle and data on one of 200 channels within the frequency range of 5031 to 5091 MHz and is normally located about 1,000 feet (300 m) beyond the stop end of the runway, but there is considerable flexibility in selecting sites. For example, for heliport operations the azimuth transmitter can be collocated with the elevation transmitter. The azimuth coverage extends: Laterally, at least 40º on either side of the runway centreline in a standard configuration. In elevation: up to an angle of 15º and to at least 20,000 feet (6 km), and in range, to at least 20 nautical miles (37 km) (See Figure 23.2-B)

**Elevation guidance**

The elevation station transmits signals on the same frequency as the azimuth station. A single frequency is time-shared between angle and data functions and is normally located about 400 feet from the side of the runway, between runway threshold and the touchdown zone.

Elevation coverage is provided in the same airspace as the azimuth guidance signals: In Elevation, to at least +15º and laterally, to fill the Azimuth lateral coverage and in range, to at least 20 nautical miles (37 km) (See Figure 23.2-C)

**Range guidance**

The MLS Precision Distance Measuring Equipment (DME/P) functions the same as the navigation DME, but there are some technical differences. The beacon transponder operates in the frequency band 962 to 1105 MHz and responds to an aircraft interrogator. The MLS DME/P accuracy is improved to be consistent with the accuracy provided by the MLS azimuth and elevation stations.

A DME/P channel is paired with the azimuth and elevation channel. A complete listing of the 200 paired channels of the DME/P with angle functions is contained in FAA Standard 022 (MLS Interoperability and Performance Requirements).

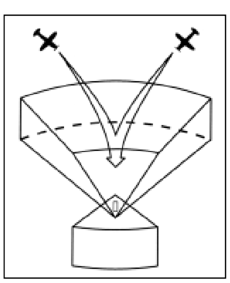
The DME/N or DME/P is an integral part of the MLS and is installed at all MLS facilities unless a waiver is obtained. This occurs infrequently and only at outlying, low-density airports where marker beacons or compass locators are already in place.

**Data communications**

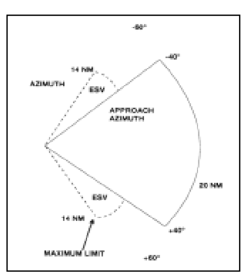
The data transmission can include both the basic and auxiliary data words. All MLS facilities transmit basic data. Where needed, auxiliary data can be transmitted. MLS data are transmitted throughout the azimuth (and back azimuth when provided) coverage sectors. Representative data include: Station identification, Exact locations of azimuth, elevation and DME/P stations (for MLS receiver processing functions), Ground equipment performance level; and DME/P channel and status.

MLS identification is a four-letter designation starting with the letter M. It is transmitted in International Morse Code at least six times per minute by the approach azimuth (and back azimuth) ground equipment [Fig 23.2- F]. Representative data for the Auxiliary data content include: 3-D locations of MLS equipment, Waypoint coordinates, Runway conditions and Weather (e.g., RVR, ceiling, altimeter setting, wind, wake vortex, wind shear).

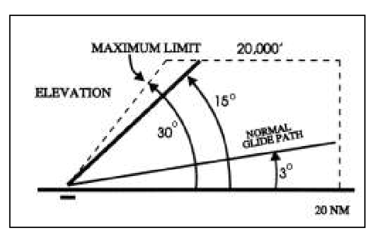
### 23.2.3 ILLUSTRATING MLS OVERAGE VOLUMES



MLS envelope coverage volumes
3-D Representation
Fig 23.2 –A (FAA PD graphic)




MLS Azimuth station
Coverage volume
Fig 23.2 - B (FAA PD graphic)




MLS Elevation station
Coverage Volumes
Fig 23.2 - C (FAA PD graphic)

### 23.2.4 ILLUSTRATING MLS TRANSMITTERS INSTALLATIONS

MLS Elevation guidance station with horizontal & vertical survey Phase Centre where shown)
Fig 23.2 – D (USGS Photo)

The NASA 737 research aircraft with the Microwave Landing System equipment in the foreground.
Fig 23.2 –E (NASA photo)

MLS Azimuth guidance station with rectangular azimuth scanning antenna and DME antenna at left
Fig 23.2 – F (USGS Photo)

### 23.2.5 PRECISION APPROACHES USING THE WIDE AREA AUGMENTATION SYSTEM (WAAS)

WAAS is an air navigation aid developed by the Federal Aviation Administration to augment the Global Positioning System (GPS), with the goal of improving its accuracy, integrity, and availability. Essentially, WAAS is intended to enable aircraft to rely on GPS for all phases of flight, including precision approaches to any airport within its coverage area.

WAAS uses a network of ground-based reference stations, in North America and Hawaii, to measure small variations in the GPS satellites' signals in the western hemisphere. Measurements from the reference stations are routed to master stations, which queue the received Deviation Correction (DC) and send the correction messages to geostationary WAAS satellites in a timely manner (at least every 5 seconds or better). Those satellites broadcast the correction messages back to Earth, where WAAS-enabled GPS receivers use the corrections while computing their positions to improve accuracy.

The International Civil Aviation Organization (ICAO) calls this type of system a Satellite Based Augmentation System (SBAS). Europe and Asia are developing their own SBASs, the European Geostationary Navigation Overlay Service (EGNOS), the Indian GPS Aided Geo Augmented Navigation (GAGAN) and the Japanese Multi-functional Satellite Augmentation System (MSAS), respectively. Commercial systems include StarFire and OmniSTAR.

### 23.2.6 HEAD UP DISPLAYS (HUD) & ENHANCED VISION SYSTEMS (EVS)

(With thanks to Captain Philip ‘Phil’ H S Smith & SEO Peter G Richards for help on this HUD/EVS extract)

**TERMINOLOGY** (EU-OPS 1.435) (Also see Appendix E for other terminologies and definitions)

EU-OPS 1.435 **–** 11: **“Head-Up Display” (HUD):** A display system which presents flight information into the pilot’s forward external field of view and which does not significantly restrict the external view.

EU-OPS 1.435 **–** 12: **“Head-Up Guidance Landing System” (HUDLS):** The total airborne system which provides head-up guidance to the pilot during the approach and landing and/or go-around. It includes all sensors, computers, power supplies, indications and controls. A HUDLS is typically used for primary approach guidance to decision heights of 50ft.

EU-OPS 1.435 **–** 13: **“Hybrid Head-Up Display Landing System” (Hybrid HUDLS):** A system which consists of a primary fail-passive automatic landing system and a secondary independent HUD/HUDLS enabling the pilot to complete a landing manually after failure of the primary system. Typically, the secondary independent HUD/HUDLS provides guidance which normally takes the form of command information, but it may alternatively be situation (or deviation) information.

EU-OPS 1.435 **–** 14: **“Enhanced Vision System” (EVS):** An electronic means of displaying a real-time image of the external scene through the use of imaging sensors.

**HEAD UP DISPLAYS (HUD)**

An aircraft head-up (HUD) display presents information to a pilot in his field of vision when he has his head ‘up’, in other words is looking outside the aircraft and not at the instrument panel. The information presented can be anything from a few of the normal aircraft instruments such as horizon, airspeed and altitude to a complete set of flight parameters including some not normally part of an aircraft instrument panel, such as angle of attack. In addition, it is possible to display items such as ‘boresight’, which is the direction in which the aircraft is pointing and ‘flight path vector’, the direction in which the aircraft is actually travelling. The HUD may also be used to present a view of the scene ahead of the aircraft. This may be obtained using sensors that can produce a satisfactory image in conditions which prevent the pilot seeing the scene normally. The HUD then becomes an Enhanced Vision System.

In many circumstances the use of a HUD, HUDLS or EVS will allow operations using minima lower than otherwise acceptable. These minima will be specified in the aircraft operator’s documentation and will be subject to the pilot(s) having received appropriate training. As with any low visibility take-off, approach or landing operation it is important that the pilot’s seating position and in particular eye position is correct.

A typical HUD contains a processor, a projector and a combiner. The combiner overlays the image from the projector on to the external view. The projector creates the image from the signal sent to it by the processor. The processor collects the data to be displayed, processes into a suitable form, taking into account distortion that may be introduced by the projector/combiner system and sends it to the projector. The image is collimated at infinity so that it remains in focus for the pilot when looking at the external scene. In military applications the projector and combiner may be mounted together on a helmet which allows the display to be available over a very wide field of view but which requires the processor to sense and take account of the pilot’s head position with great accuracy. Civil HUDs are fixed to the airframe, although it may be possible for the combiner to be moved out of the way when not in use. This allows the combiner to be relatively close to the pilot, which allows a larger field of view from a given size of combiner but requires that when in operation, the position of the combiner can be accurately fixed.

It is possible to generate a synthetic image of the runway, using highly accurate position and attitude data, without an external sensor thus producing a Synthetic Vision System. However, these are not in use in commercial passenger transports.

**CIVIL AIRCRAFT SPECIFIC APPLICATIONS**

Wikimedia NASA PD photo
NASA's Gulfstream G-V cockpit
(with synthetic vision system display)

Wikimedia CC -2.0 Telstar Logistics photo
C-130J Hercules Co-pilot's Head up display (HUD)

The use of head-up displays allows commercial aircraft substantial flexibility in their operations. Systems have been approved which allow reduced-visibility takeoffs and landings, as well as full Category 3B landings with a less than 50 feet DH, down to Nil DH.

The photo on the left is of a HUD in a NASA Gulfstream V. It shows several different HUD elements, such as the transparent combiner in front of the pilot. When not in use, this combiner can swing up and lock in a stowed position.

**Displayed data**

A typical aircraft HUD displays airspeed, altitude, a horizon line, heading, also a turn/bank and slip/skid indicators. Other symbols and data are also available in some HUDs such as:

1. A ***Boresight*** or ‘***waterline’*** symbol (¯v¯) or (—O—) which is a fixed graphic on the display that shows where the nose of the aircraft is actually pointing.

2. A ***Flight path vector (FPV)* or *‘velocity vector’*** symbol: which shows where the aircraft is actually going (that is, the sum of all forces acting on the aircraft). For example, if the aircraft is pitched up but is losing energy, then the FPV symbol will be below the horizon even though the boresight symbol is above the horizon. During approach and landing, a pilot can fly the approach by keeping the FPV symbol at the desired descent angle and touchdown point on the runway.

3. An ***Acceleration indicator* or *‘energy cue’*** which is typically placed to the left of the FPV symbol. It is above it if the aircraft is accelerating, and below the FPV symbol if decelerating.

4. An ***Angle of attack indicator*** that shows the wing's angle relative to the airflow termed *"α"*. (Alpha)

5. ***Navigation data and symbols*** for approaches and landings. The flight guidance system can provide visual cues based on navigation aids such as an Instrument Landing System (ILS), Microwave Landing system (MLS) or augmented Global Positioning System (GPS) like the Wide Area Augmentation System (WAAS). Typically this is a circle (O) which fits inside the flight path vector symbol. By "flying" to the guidance cue, the pilot keeps the aircraft along the correct flight path.

Since being introduced on HUDs, both the FPV and acceleration symbols are becoming standard on head-down displays (HDD). The actual form of the FPV symbol on a display is not standardized but is usually a simple aircraft drawing, such as a circle with two short angled lines, (180º ± 30º) and "wings" on the ends of the descending line. Keeping the FPV on the horizon allows the pilot to fly level turns in various angles of bank.

**ENHANCED FLIGHT VISION SYSTEMS (EVS)**

**Overview**

1. The detailed requirements for EVS are published in EU-OPS 1, Sub-part E (All Weather Operations) Ops 1.430, Appendix 1 (New), sub-paragraph (h) - (See Appendix E).

2. An EVS uses modern technology (currently infra-red) to overlay an image of the surrounding topography on a head up display, allowing the pilot to see the surrounding terrain in low visibility conditions.

3. Suitably approved aircraft operators will be able to conduct Category 1 precision approaches and APV approaches in reduced RVR, down to a minima of 350 metres Table 9 of EU-OPS 1, Subpart E (All Weather Operations) Ops 1.430, Appendix 1 (New) sub-paragraph (h) gives the reduction allowed to the RVR normally required, if using an EVS - (See Appendix E).

4. Using an EVS, a pilot may continue an approach below DH or Minimum Descent Height (MDH) to 100 feet above the threshold elevation of the runway provided at least one of the visual references prescribed in EU-OPS is displayed and identifiable on the EVS. A pilot may not continue an approach below 100 feet above the runway threshold elevation, unless at least one of the visual references prescribed in EU-OPS is distinctly visible and identifiable to the pilot without reliance on the EVS.

**Requirements**

1. There are no additional navigation or lighting infrastructure requirements to take advantage of the reduced RVR. However, Aerodrome operators should be aware there may be an issue with the introduction of Light Emitting Diode (LED) lighting systems, as LED infrared signatures are not compatible with existing EVS equipment.

2. To ensure that an aerodrome can operate at lower RVR minima for suitably approved aircraft operators with EVS, it will .be necessary to review and where necessary revise LVPs to ensure their compatibility with operations at the minimum RVR values.

3. It will be necessary to review the aerodromes absolute minima procedures

The key benefits of an EVS system are that they enhance crew awareness of the aircraft's position relative to the runway and surrounding terrain. They also improve monitoring and control of the aircraft's energy state and the flight path through intuitive display of attitude, path-vector and acceleration. EVS also improves stability and precision on landing approaches, including "black hole" approaches to airports not equipped with precision landing aids

In more advanced systems, such as the FAA-labeled *Enhanced Flight Vision System*, a real-world visual image can be overlaid onto the combiner. Typically an infrared camera (either single or multi-band) is installed in the nose of the aircraft to display a conformed image to the pilot. When used with a HUD, the camera is mounted as close as possible to the pilot's eye point, so that the image "overlays" the real world as the pilot looks through the combiner.

Features include full field-of-view infrared video overlaid on head-up display, which allows pilots to 'see' the runway environment before it is visible to the unequipped eye; whilst inertial flight path indication provides instantaneous symbology of where the aircraft is headed. The runway remaining displayed during landing rollout, contributes to smoother deceleration, whilst cross-wind and wind-shear indications enable more accurate flight path control, together with keeping pilots' attention focused outside the windscreen.

Enhanced Flight Vision Systems fully integrate live infrared imagery of the landing environment with precise head-up guidance cues, providing improved landing performance and increased situational awareness during all phases of flight.

**SYNTHETIC VISION SYSTEMS (SVS)**


Wikimedia Commons NASA PD photo

HUD systems are also being designed to utilise a synthetic vision system (SVS), which use terrain databases to create a realistic and intuitive view of the outside world.

In the SVS screen image to the left, immediately visible indicators include the airspeed tape on the left, altitude tape on the right with turn/bank and slip/skid displays at the top center. The 'boresight' symbol (¯v¯) is in the center and directly below that is the Flight Path Vector symbol (the circle with short wings and a vertical stabilizer). The horizon line is visible, going across the display with a break at the center. Directly to the left are the numbers at ±10° with a short line at ±5° (The +5° line is easier to see) which, along with the horizon line, show the pitch of the aircraft.

The aircraft in the image is wings level (i.e. the flight path vector symbol is relative to the horizon line and there is zero roll on the turn/bank indicator). Airspeed is 140 knots, altitude is 9450 feet and the heading is 343° (the number below the turn/bank indicator). Close inspection of image shows a small purple circle which is displaced from the Flight Path Vector slightly to the lower right. This is the guidance cue coming from the Flight Guidance System. When stabilized on the approach, this purple symbol should be centered *within* the FPV.

The terrain is entirely computer generated from a high resolution terrain database.

In some systems, the SVS will calculate the aircraft's current flight path, or its possible flight path (based on an aircraft performance model, the aircraft's current energy, and surrounding terrain) and then turn any obstructions into RED to alert the flight crew. Such a system might have prevented the crash of American Airlines Flight 965 in 1995, which crashed into a mountain in Buga, near Cali, Colombia. (See Part 3 - 19.1.2 - Loss of Situational Awareness)

On the left side of the display is an SVS-unique symbol, which looks like a purple, diminishing sideways ladder which continues on the right of the display. The two together define a *"tunnel in the sky".* This symbol defines the desired trajectory of the aircraft in three dimensions. For example, if the pilot had selected an airport to the left, then this symbol would curve-off to the left and down. The pilot keeps the flight path vector alongside the trajectory symbol, to fly the optimum path. The path would be based on information stored in the Flight Management System's data-base and would show the approved Regulatory Authority approach for that airport.

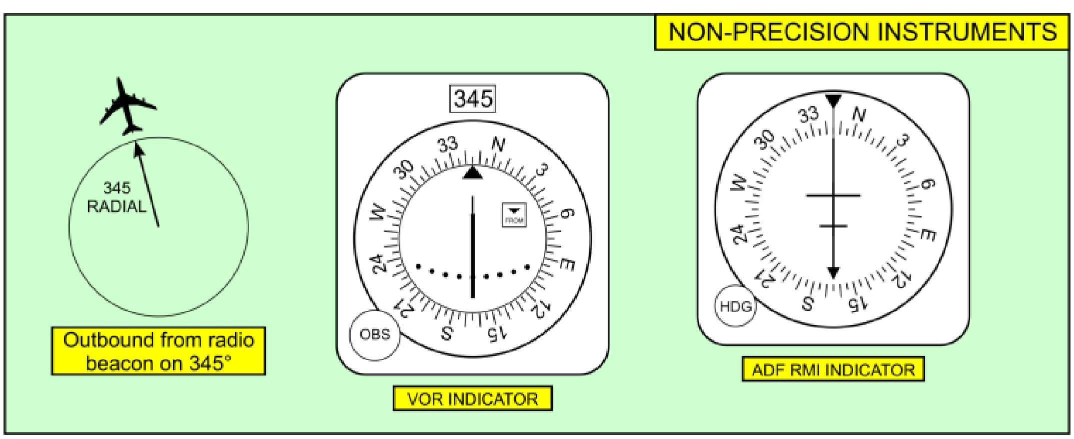
The *'Tunnel in the Sky"* can also greatly assist the pilot when more precise four-dimensional flying is required, such as for the decreased vertical or horizontal clearance requirements of RNP. Under such conditions, the pilot is given a graphical depiction of where the aircraft should be and where it should be going, rather than the pilot having to mentally integrate altitude, airspeed, heading, energy AND longitude and latitude to correctly fly the aircraft.

**Airbus A380** **Wikimedia Creative Commons 2.0 generic licence**

### 23.3 THE NON - PRECISION APPROACH

A non-precision approach is pilot-interpreted and does not give electronic glide path progress indications. It may or may not offer a visual tracking facility, such as when using a VOR set to the runway QDM / QDR, if in-line with the runway and so showing indications of departures from the required track.

23.3.1 Non-Precision Approach Equipment




As explained in a number of places in this Publication, the non-precision approach is better flown precisely; as a continuous descent to MDA, continuing to touchdown and not as a *Dive to* MDA then *'Drive'* profile (flying level whilst low, looking for the runway). **Dive and Drive is not at all recommended.**

## 23.4 THE APPROACH

**Definitions used in this Section may be found in Appendix I.**

### 23.4.1 Handling the Approach

Before commencing any approach, ensure that the weather is within limits at the destination airfield and also that the weather for the alternate is within limits and forecast to be so for the time of arrival, after diversion. This is best done before the top of descent. Obtain the latest Runway Visual Range (RVR) prior to commencing the approach. Before commencing the descent, it is also necessary to do a fuel check to ensure that there is sufficient fuel on board for the approach, Go-Around, diversion and reserve. At this point a decision can be made as to whether it is possible to fly a second approach, should the first approach fail for any reason. Always be ahead of the operation, don't get caught out.

An accurate approach, whether instrument or visual, followed by a smooth and safe landing, is started way back before the final descent point. On reaching the platform altitude, i.e. the altitude where the aircraft flies level prior to intercepting the Glide Path, the pilot must be ahead of the operation and have the aircraft totally under control, configured with the intermediate approach flap setting and flying at the correct Reference Speed for that flap setting. If this is not the situation, then there is the likelihood of a "Rushed Approach" and serious consideration should be given to commencing a Go Around, if the Final Descent Point is near. A rushed approach on the final descent causes over controlling and excessive power changes. These frequently lead to unnecessary trim changes which aggravate the situation even further. The end result is an unsafe, deep landing, with the possibility of an over-run, causing structural damage at the very least. Most operators recommend that the approach be stable between 1,000 ft and 500 ft above ground level. Below 500 ft, if the approach is not stable, then an immediate Go Around must be executed (See page 12, Figure 6.). The jet aircraft is an instrument platform during all types of approach, even when doing a visual approach. Reference to instruments must be made at all times. Therefore a visual approach is identical to a full ILS approach.

***The following notes cover the techniques, which are taught to new Training Captains on the Type Rating Instructor (TRI) Core Course. The three types of approaches, visual, precision and non-precision are explained therein*.**

When flying any commercial aircraft, it is most important to know your datum power and attitude settings for a given speed and flap configuration. A modern jet is very like a computer. Set the correct datums and it will give you the correct speed. But it must be remembered that a jet suffers from inertia, so after the power and the attitude have been set, the pilot should PAUSE to allow the inertia to settle before trimming, in order to avoid over trimming. When trimming, small "Blips" rather than long bursts of trim should be applied. Hence the formula:-

**PA,T = Speed**
**P** = **P**ower setting.
**A** = **A**ttitude.
, = Pause to allow the inertia to stabilise.
**T** = **T**rim.
**S** = **S**peed (Desired speed for Flap setting).

### 23.4.2 The Visual Approach

For new commanders, the following procedure may be worth considering, rather than to fly more restrictive noise abatement approaches when gear and flaps are lowered at later stages of the approach as more experience is gained.

Upon reaching the "fly level altitude" to the Final Approach Fix (FAF), or Platform Altitude, the handling pilot will maintain it, say 1,500 feet, and :

1. Capture and establish the aircraft on the Localiser / Centre Line.
2. At 2 miles from the descent point or 1½ Dots fly up on the Glide Slope, select:
   a. Gear Down.
   b. Intermediate Flaps (e.g.15º).
3. Set the correct Power.
4. Set the correct Attitude, then Pause
5. Trim the Aircraft.
6. Check Target Speed achieved.
7. Call for the landing checklist.

Then,

8. At ½ a mile from the descent point or ½ a dot fly-up on the Glide Slope: -
    a. Call for landing flap (at which point all of the landing checklist will be complete).
    b. Most aircraft balloon slightly at this point, so he anticipates it and,
    c. Pitches aircraft gently down into the Glide slope.
9. By initiating the pitch into the Glide Slope slightly before the Glide Slope capture, one compensates for the aircraft inertia which wants to continue through the Glide Slope, leaving one high (*Anticipation)*

**Between 1,500 ft and 1,000 ft.** (See Figure 23-4A)
The pilot looks **IN, twice as often** as looking **OUT**.

**Looking *IN,* the pilot:**

1. Sets the Power.
2. Sets the Attitude.
3. Adjusts the Trim, after a short pause, allowing for the inertia.
4. Establishes on the ILS Glide Path, if available.
5. Checks the Rate Of Descent. (*For a 3º Glide Path use half the ground Speed x 10, or 5 times the ground speed (E.g. 140 kts = 700 feet/minute.)*
6. Adjusts attitude to achieve the required rate of descent.
7. Notes the new Pitch Attitude.

**Looking *OUT*:** (See Figure 23-4C)

1. Looks at the Aiming Point, (Flare Point) which is the centre of the Runway: -
    a. Abeam the Precision Approach Path Indicator (PAPI) alongside the 1,000 ft Mark.
    b. With the Vertical Approach Slope Indicator (VASI) abeam the mid-point of the 2nd or 3rd bars (1,000 ft. Mark)
    c. This aiming point should be a 1/4 to 1/3 up the centre post of the pilot's Windscreen. (See Figure 22-3)
2. Checks aircraft tracking, approach lights centre line running between the legs.
3. Checks the aircraft is on the PAPI / VASI Glide Path.

**Between 1,000 ft and 500 ft** (See Figure 23-4A)
The pilot looks **IN** an **equal** amount as looking **OUT**.

**Looking *IN,* the pilot:**

1. Checks the attitude: (e.g. on a B737-300, with Flap 30º & on the Glide Path, the attitude = 3½º Nose up with power set to 55% N1)
2. Checks the speed.
3. Checks rate of descent.
4. Checks the ILS is *'On Localiser'* & *'On Glide Path'*, if available.
5. Checks and notes the Pitch Attitude.
6. On EFIS aircraft, looks at the Map if there is no visual Glide Path. As the 2½ mile range marker touches the end of the runway, the on Glide Path height should be 750 feet plus airfield elevation.
7. Keeps Wings level and aircraft stable.

**Looking *OUT:*** (See Figure 23-5C)

1. Checks the Aiming Point.
2. Checks aircraft tracking, approach lights centre line running between the legs.
3. Checks on PAPI / VASI Glide Path.

**Between 500 ft to 200 ft** (See Figure 23-5A)
The Pilot looks **OUT, twice as often** as looking **IN**.

**Looking *IN,* the pilot:**

1. Checks the attitude remains constant. Checks the speed, then gradually reduces it to the required target **Vref** speed, other than in turbulent conditions when the additional gust factor should be maintained
2. Checks rate of descent.
3. Checks the ILS, *'On Localiser'* & *'On Glide Path'*, if available.
4. Ensures that the aircraft is stable, if not, – **Go-Around** (See Figure 23-5B)

**Looking *OUT,* the pilot:** (See Figure 23-C)

1. Keeps the Aiming Point in the correct place.
2. Checks aircraft tracking, approach lights centre line running between the legs.
3. Checks on PAPI / VASI Glide Path.
4. **DOES NOT** look at the Threshold. (The aircraft will go to where the eyes are looking)

**Below 200 ft to the Runway (**See Figure 23-5A)
The Pilot looks ***OUT*** at the Aiming Point.

**Looking *OUT,* the pilot:** (See Figure 23-5C)

1. Crosses the Threshold, maintaining attitude.
2. Continues to look at the "Aiming Point."
3. Waits for the Runway edge lights to almost touch the bottom of the ear lobes.
4. Looks down the Runway to the stoplights at the far end.
5. Halves the Rate of Descent (ROD) at 50 feet for a B747 or 30 feet for an A320 / B737 size aircraft, by way of a small nose-up input, (known as a 'chicken check', to stop the aircraft from continuing towards the ground at the higher rate of descent, before the flare is initiated) then selects the **Flare Attitude**. (See Figure 23-4)
6. Lands the main wheels, then lands nose wheel and keeps on the centreline down to taxi speed, then clears the runway.

**Be the aircraft large or small, the technique remains the same …**

**PA-28 G-BPDT on short finals - Jersey (Channel Islands) Airport**

Wikimedia Commons PD photo by Tswgb

**PAPI shows 3 reds = 2.8º instead of the target 3º approach path**

## 23.5 APPROACH PROFILES WITH FLARE AND LANDING GUIDANCE

23.5.1 Descent profiles illustrations

A. Final Approach segments (Figure 23-5A)
B Stable approach Decision Points (Figure 23-5B)
C. Visual clues on Approach (Figure 23-5C)
D. The Flare Attitude (Figure 23-5D)
E Final approach descent phase (Figure 23-5E)
F. Non-Precision Approach Clock Illustration (Figure 23- 5F)
G. Target Let-down Profile (Figure 23-5G)
H. The non-precision approach – "dive & drive" (Figure 23-5H)

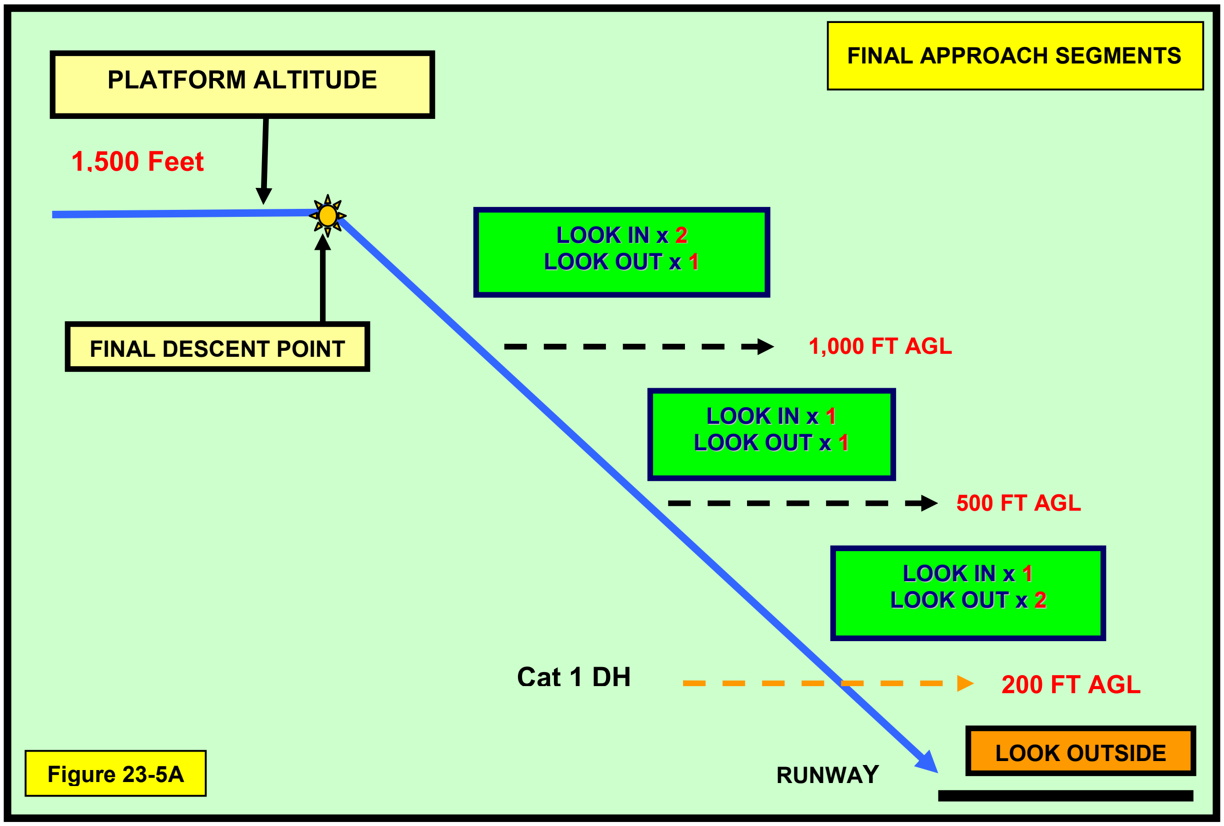



Figure 23-5A

Note that the view from the left hand seat will be exactly as seen from the right hand seat (Figs 23-5C & 23-5D) but the flight deck environment will seem strange, with windows and window frame pillars reversed and, in addition, the nose-wheel steering handle to deal with.

The new Captain will need to become familiar with seeing things from a different perspective and also get used to handling with left hand on the control column and the right hand on the throttles (power levers).

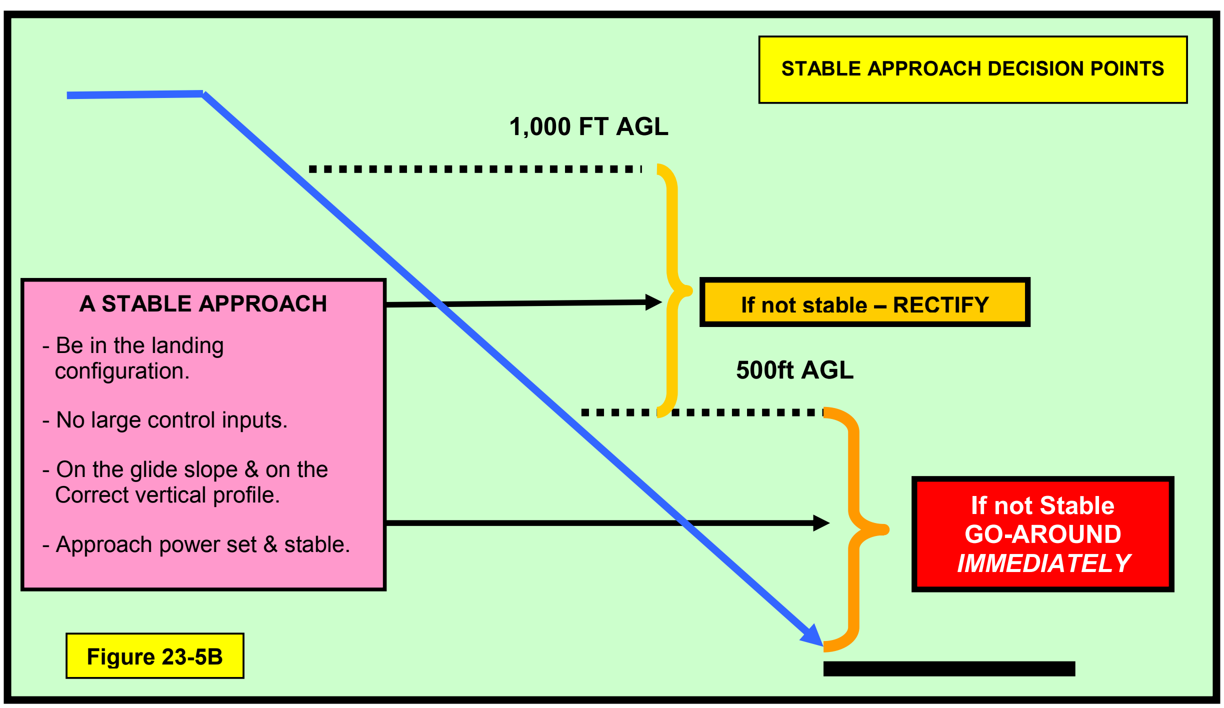



Figure 23-5B

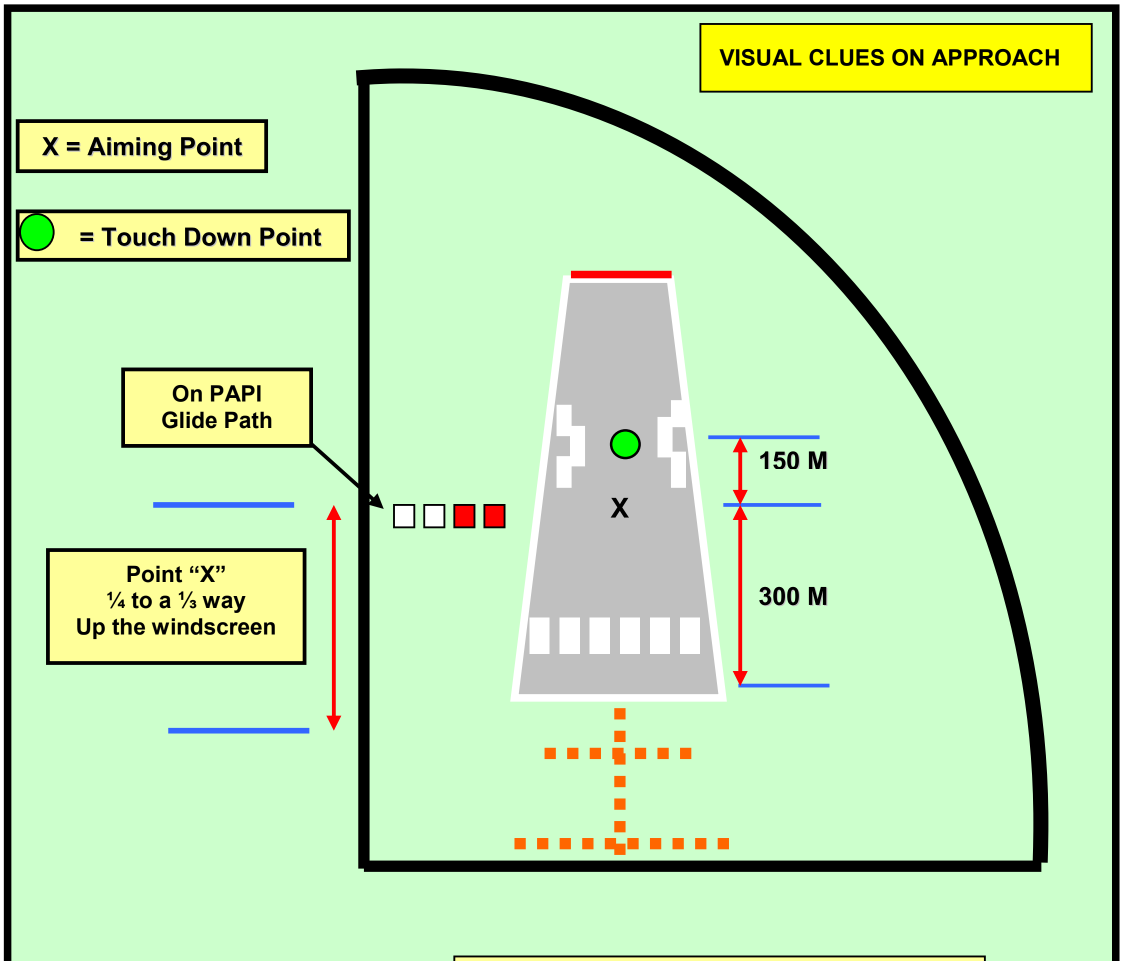



Figure 23-5C

**The Flare** (See figure 23-5D)

1. Select the Flare attitude by raising the pitch attitude, (Approximately 3º) such that the Red Stop Lights are midway between the coaming and where the aiming point "X" was on the windscreen.
2. Close the Thrust levers (Nose will want to drop) *Anticipate*.
3. Maintain the pitch attitude, adjusting slightly to keep the screen aiming point touching the red stop end lights.
4. Aircraft touches down at the 1,500 ft touch down point.
5. Select reverse. (Nose will want to drop, *Anticipate,* hold Flare attitude)
6. Select or call for speed brake.
7. Lower the nose wheel gently onto the runway.
8. Keep the aircraft straight on the Runway.
9. Select reverse idle at 60 kts Ground Speed.
10. Vacate runway when speed is below 10 kts ground speed, if there is no high-speed turn off.

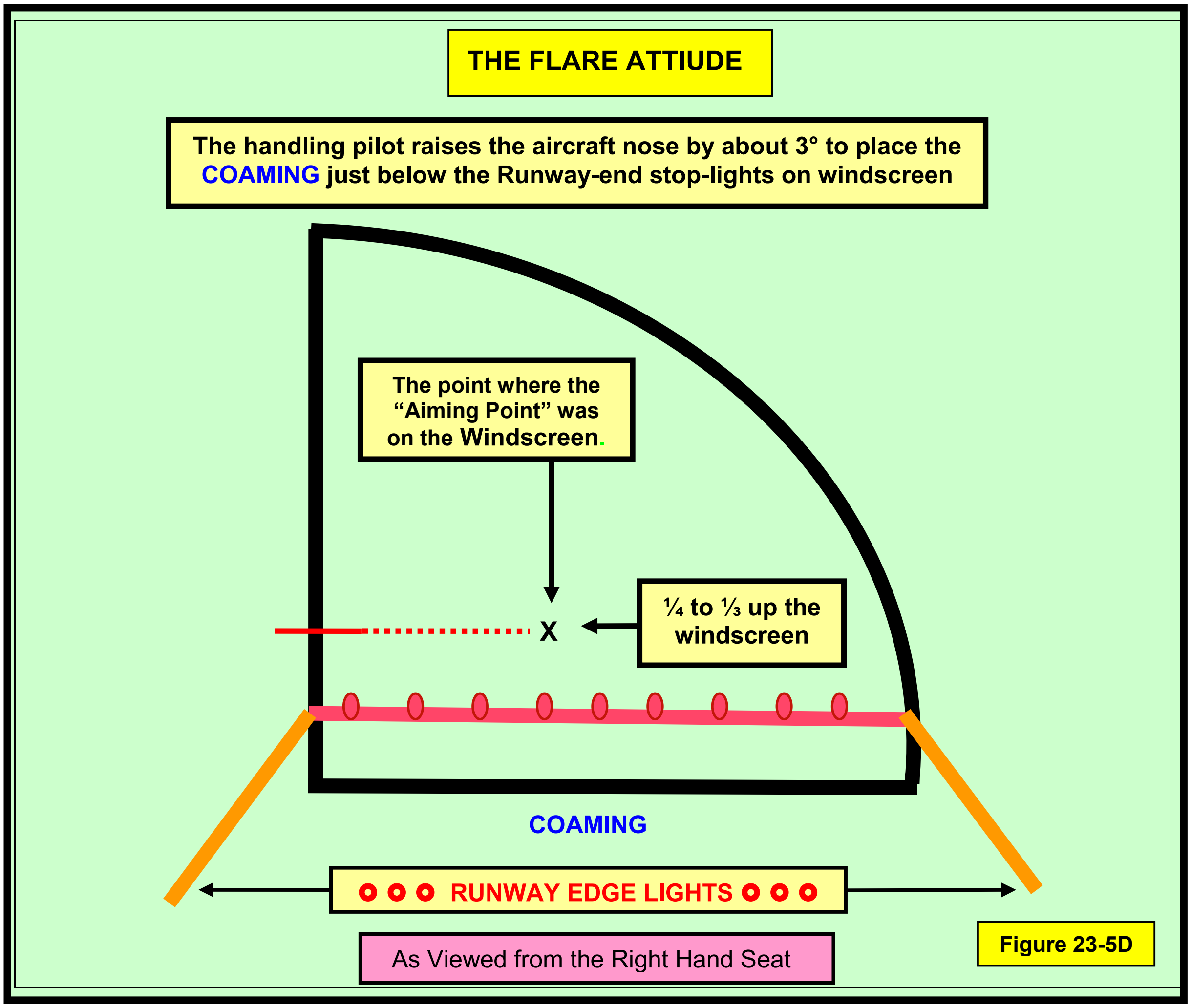


Figure 23-5D

**23.6 THE PRECISION APPROACH (ILS)**

The term ILS as used, also covers current MLS equipped aircraft. MLS is used exactly like ILS at airports where such equipment is available and is pilot selectable where installed. An ILS/MLS approach 'On Instruments' is flown exactly like a visual approach in terms of aircraft handling and configuration settings, but head down and without looking out; except that the following additional points apply:

1. Get established on the Localiser as early as possible.
2. Monitor the ADF RMI; if there is an NDB, this will give rate of closure to the Localiser. Treat the RMI as the pilot's friend, it helps *anticipation*.
3. When turning onto the Localiser, the moment the Localiser starts to move off the stops, commence a 25º bank turn initially, to get the aircraft to respond (Inertia). Then hold 25º or reduce the bank angle as necessary to capture the Localiser. If less than 25º of bank is used initially, the aircraft will skid through the Localiser.
4. Make small smooth adjustments once established on the Localiser. Remember the jet aircraft inertia, that takes a while to change direction; but when it does, it moves fast and is then difficult to stop, especially if the changes have been too large. Large corrections de-stabilise the approach, causing loss of speed, which then requires power which upsets the trim. Lean on the controls gently, as this will stop large inputs. The jet aircraft requires gentle but positive inputs.
5. Keep heading changes to 5º either side of the inbound QDM when on the Localiser in final descent, be patient it will respond.
6. Above all "Anticipate".

On break-out of cloud, all the visual cues are the same as for the "Visual Approach." But beware, when changing from instruments to going visual, there is a tendency to sit up, rather than just moving the eyes to the aiming point. By sitting up, the control column is pulled back a small amount, causing the aircraft to balloon and then float. This, in turn, can easily cause a 'deep' landing.

## 23.7 THE NON PRECISION APPROACH

**The Non-Precision Approach, is any approach which does not have an instrument glide-slope. These are: -**

| | | |
|---|---|---|
| 1. | ILS localiser only. . . . . . | These approaches may be flown with or without DME |
| 2. | VOR. | |
| 3. | ILS back beam. | |
| 4. | NDB. . . . . . . . . . . . . . . | |

5. VDF
6. PAR with no glide slope information

There are two types of NDB let-downs :-

a. The continuous descent approach to Minimum Descent Altitude (MDA) is usually associated with a DME. On reaching MDA, an immediate Go-Around must be initiated. On a continuous descent approach, MDA should be treated as though it was a Decision Altitude (DA).

b. The descent to Minimum Descent Altitude (MDA) and then to fly level to the Missed Approach Point (MAPt). This is called “Dive & Drive” and is **NOT** recommended. It is a discredited procedure in terms of ‘Flight Safety’ because it has caused numerous CFIT accidents.

The “Continuous Descent” is the approach that is recommended for all aircraft, since it is much more stable and does not have configuration changes at a very low altitude, which can cause instability just prior to the threshold, i.e. ballooning and a deep landing.

There is no reason why single pilot operations should not fly stabilised continuous descent approaches in preference to dive and drive. It is essential however to prepare a cross-check crib of required height at each 15 second point after passing the FAF or DME distance, all the way to touchdown, for easy reference during the approach.

## 23.8 THE CONTINUOUS DESCENT NON-PRECISION APPROACH

All aircraft should fly an NDB approach in the same way as an ILS. A continuous 3º descent is planned, by flying the appropriate rate of descent as mentioned previously. (Half the Ground Speed multiplied by 10, or 5 times the Ground Speed). In addition:

1. The beacon identification ‘Morse’ group must be continuously monitored during the approach, in case of failure, which will cause the RMI needle to ‘freeze’ and may not be noticed; also
2. Get established on the inbound QDM as early as possible.
3. Monitor the ADF RMI; this will give rate of closure to the inbound QDM.
4. Make small smooth adjustments once established on the QDM.
5. Lower Gear and flaps at 2 nautical miles from descent point, usually the FAF.
6. Call for and do the landing checks. These need to be out of the way before the descent point, since the non-handling pilot needs to be able to monitor and call out the height versus distance in the descent.
7. At ½ a nautical mile select landing flap, remember that the aircraft will balloon slightly, check the flap and have the checklist put away.
8. Pitch into the descent profile. Since the jet suffers from inertia, it cannot change from level flight to the required rate of descent instantly, so it is recommended that the initial rate of descent be greater than the planned rate of descent. For example, ‘Planned’ ROD = 700 ft/min (½ Ground Speed x 10). Commence initial rate of descent at 1,000 ft/min. By doing this the aircraft will regain the Glide Path, then set the required ROD when back on the Glide Path, (see figure 15-5.)
9. The non-handling pilot should call out the heights and distance thus
   a. “At 8 miles you should be 2,400 feet”
   b. “8 miles, 100 ft high, at 7 miles you should be at 2,100 feet,” etc”

   If there is no DME, call the target height at each 15 seconds (See figure 23-8) thus

   c. “At +15 seconds you are 100 feet high. Aim for 1100 feet at +30 seconds,”
   d “At + 30 seconds you are 50 feet high. Aim for 900 feet at +45 seconds, etc.”
   e. Continue calls all the way to touchdown, particularly at night and when the MDH/A is high.

***The non-handling pilot needs to make the calls in a crisp manner and then stay quiet, so that the handling pilot can think and adjust the flight path accordingly.***

10. When going visual, particularly in a strong cross wind, the handling pilot must freeze the heading that is being flown. Otherwise the immediate reaction is to roll towards the runway removing all the drift and going onto the down wind side. This will then necessitate an “S” turn to get back onto the centre line. In so doing, there will be a considerable height loss.
11. The visual cues are now all the same as on all previous approaches.
12. Again “Anticipate”.
13. ***If at any time you are not comfortable with your progress, GO AROUND!***

23.8.1 Initiating Final Descent from an initial platform attitude prior to final descent

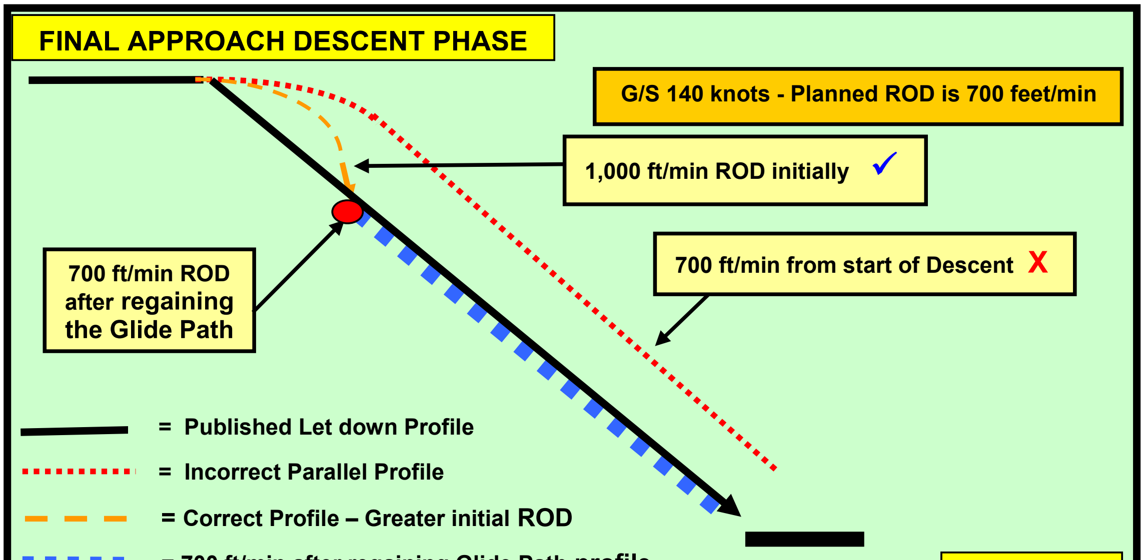


Figure 23-8A

During an instrument approach it is best to pass the FAF at no more than the +100 feet tolerance permitted but preferably -0 feet, so as not to erode terrain clearance. When a positive indication of desired progress is confirmed, descent may re-commence: then you need to maintain the intended approach slope, even if this means an initial rate of descent slightly higher than the normal target of about 700 feet/minute, now in the landing configuration.

23.8.2 Non-Precision Approach 'Clock' for descent profile progress-control

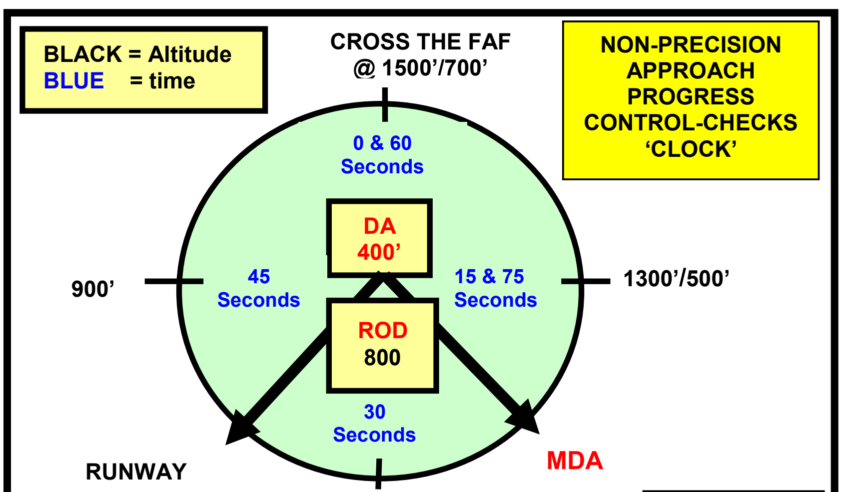


Figure 23-8B

**Enter Target Rate of Descent: 800 feet per minute in lower (ROD) box within circle.**
**Then also enter:**

**FAF height** **1500** feet (Enter in space provided above circle)
**DA** **400** feet (QNH) (enter in upper (DA) box within circle)
**Airfield Elevation** **200** feet (adjusted for threshold / TDZ elevation if significant)

To maintain a 3° approach slope, use 5 times the ground speed (G/S), or half the Groundspeed x 10.

a. So for a groundspeed of 140 kts use 140 x 5 = 700 feet / minute; or

b. ½ G/S x 10 = (140 ÷2) x 10 = 70 x 10 = 700 feet / minute.

**Note that the choice of 15 seconds, as the interval at which progress is measured during the descent, is intentional, as against the 20 seconds height checks favoured by some proprietary let-down plate providers such as *'Aerad'.* Most importantly, the time to DH/DA, then to touchdown is also pre-calculated and noted on the 'clock'. By checking progress every 15 seconds, the pilot makes a more frequent position assessment, allowing smoother, gentler corrections to the flight path as required. By allowing a longer period to elapse between checks will result in an increase in the magnitude of any departure from the desired path that then requires a greater correction.**

**Reading the clock:**

| At TIME | TARGET ALTITUDE in feet (QNH) |
|---|---|
| +15 seconds | 1300 |
| +30 | 1100 |
| +45 | 900 |
| +60 | 700 |
| 1M +15 | 500 |
| 1M +23 | **400 DA** |
| 1M +30 | 300 |
| 1M +42 | **200** Runway Threshold (DA + 15) |

a. DA is reached once round the clock at 75 + 7.5 seconds.
b. Time to runway is easily interpreted as DA + 15 seconds.

**Timing for checks all the way to touchdown is useful, particularly at night, where NPA procedures terminate at a high MDA. For example, in Montreal (Mirabel, CYMX), on the now closed runway 11, the non-precision approach MDA was 1200 feet whilst still at some four nautical miles from the threshold; leaving the pilot looking at a black hole at night with a barely visible, short, single centre-line, red approach lights in sight. A continued time versus height progress check into an otherwise black view ahead, is most helpful in such cases**

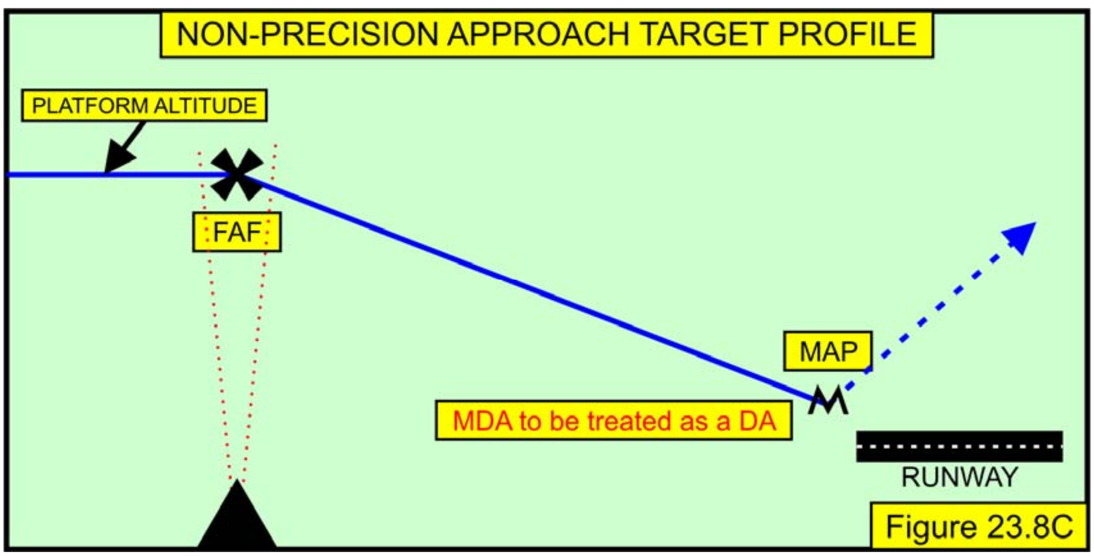


Figure 23.8C

## 23.9 DIVE & DRIVE APPROACH
(Figure 23-9A)

**"Dive & Drive" is *NOT* recommended, as it is discredited throughout the well-developed airline operations regions. The reasons that a "Dive & Drive" approach is not recommended are:**

1. A higher than normal rate of descent below 1,500 ft, which could trigger a GPWS.

2. A huge power change at the level off Minimum Descent Altitude (MDA) causing large trim changes and, in turn, instability.

3. The pilot of an aircraft does not want to be hunting around for the runway in poor visibility at 400 feet, as well as managing the aircraft. It is very easy to drop below MDA and jeopardise obstacle clearance.

4. Further power and trim changes occur if the runway is seen and a landing is attempted, causing a "deep landing" and all the associated problems of such landings, particularly difficult speed control and runway over-runs.

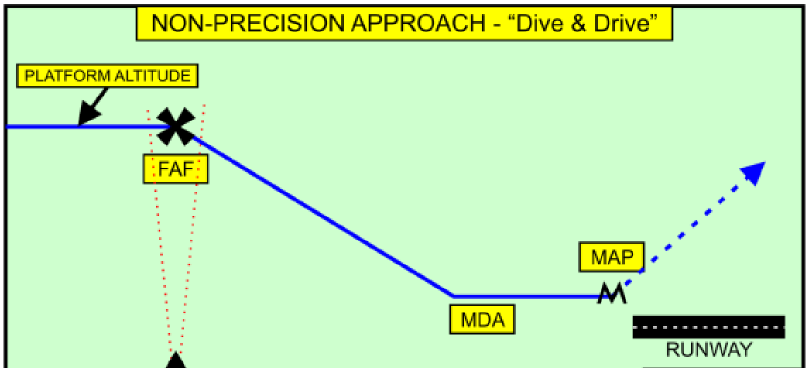


Figure 23.9A

## 23.10 DEFINITIONS
**(See Appendix E in AOM for the full underpinning ICAO definitions & also Appendix I)**

## SECTION 24 - INSTRUMENT FLIGHT AND HANDLING TEST TOLERANCES

### 24.1 TOLERANCES (EASA, EU-OPS and UK CAA)

During EASA, EU/JAR OPS FCL-1 and UK CAA instrument flight and handling competency tests, pilots demonstrate their ability to fly to the following tolerances. When flying on normal operations, pilots are expected to stay within these tolerances to satisfy IFR operations limits, so remaining in the designed airspace and inside the let-down envelopes.

| **Altitude or Height** | **Tolerance** |
|---|---|
| Normal Flight | ± 100 feet |
| With simulated engine failure | ± 100 feet |
| Starting go-around at Decision Height/Altitude | + 50 feet / - 0 feet |
| Starting go-around at Minimum Descent Height/Altitude | + 50 feet / - 0 feet |
| **Tracking** | **Tolerance** |
| All except precision approach | ± 5° |
| Precision approach | Half-scale deflection azimuth and glide path |
| **Heading** | **Tolerance** |
| All engines operating | ± 5° |
| With simulated engine failure | ± 10° |
| **Speed** | **Tolerance** |
| Climb, Cruise and approach - Non-jet | ± 5 knots Never below Vref |
| Climb, Cruise and approach - Jet | ±10 knots Never below Vref |
| Asymmetric | +10 knots/- 5 knots but Never below V2 or Vref |

24.1.2 Engine failure at take-off, Considerations and Test Tolerances

Surprisingly, in the new world of EASA, JAR & EU-OPS et al, there is no published 'Heading' tolerance given for swing on Engine Failure at Take-off (EFATO) in either EU-OPS FCL-1 Sub Part E (Instrument Rating) or Sub Part F (Skill proficiency check).

The UK CAA states in *Standards Document 24* at *'2.5 Engine failure at take-off (EFATO)'*, quote*:*
*"A question often asked is, how much swing is acceptable on an engine failure? There are no published tolerances. Each aircraft type has its own characteristics and this in turn will depend on the time of the engine failure and the failure given"…* That does not imply that during a test of competence, the candidate can weave all over the sky. Control must be gained in a timely manner and the SID and/or any emergency turn procedure complied with.

You will clearly recall that, if an engine fails or is simulated failed during take-off after V1 but before Vr, it is essential to stay on the runway centreline and return to it if a departure from it has occurred; essentially to remain on the paved area. When on a reduced/de-rated power take-off, remember that you have additional power available. Thrust should normally be increased (with the appropriate rudder input) to take-off power, or even full throttle thrust if SOPs allow and with due regard to time and engine limitations. Reduced thrust may be retained if SOPs allow and if there is no doubt at all that performance will be adequate without the increased power. Take account of the fact that the time to clean up and accelerate will be very significantly increased with reduced thrust. When the time limit is reached or when the clean up and acceleration is complete, thrust should be reduced to Max Continuous. Remember that use of the automatic systems when SOPs allow will reduce the workload considerably.

At Vr, a gentle rotation is made and lift-off occurs. Up to Full opposite rudder (dead leg … dead engine … remember?) may be required to counteract the swing whilst still rolling on the runway, then in the air when at, or close to, V2. Some opposite aileron is needed to raise the ‘dead side’ wing by about 5 degrees to stay straight whilst climbing along the extended runway centreline, or trying to regain it. It is not unreasonable to expect the pilot to contain any swing to ±15°, then return to the extended centreline during this initial climb, aiming to climb-away initially at V2 or V2+10 if achieved. Clearly, a cross-wind situation compounds the difficulties in terms of Track made good in relation to limiting terrain, so tracking needs to be correct. Notwithstanding all the technical things you might need to deal with soonest, avoiding close obstacles in such a situation should always be at the front of your mind, particularly where the area you are flying over is not flat.

The old tolerance used in days gone by, when I was actively involved with examining, is not at all unreasonable to aim-for in the first instance. A swing tolerance limited to about ±15º from the runway heading (the old tolerance), is a reasonable figure to strive-for during initial climb-out, after an Engine Failure at take-off soon after V1. However, if the swing is not contained to this amount, contemporary examiners will not consider the larger swing to be a fail point. How large the swing they will allow, is in their giving.

24.1.2 Fail Points

For information, further guidance for Examiners sets upper limits beyond which a ‘fail’ assessment will be made, but the examiner will make allowances for turbulent conditions and the aircraft’s handling qualities and performance, when carrying-out a competence test in an aircraft in flight. Tolerances apply to all tests, whether on simulators or in aircraft in flight. The absolute fail points are

| | |
|---|---|
| Height errors | Error of more than 200 feet occurs<br>Error <100 feet remains uncorrected for long |
| Speed errors | Maximum speed : 15 knots at any time<br>Climb : Less than V2<br>Approach : Less than Vref |
| Before commencing Approach, above 1000 feet | Not checking RVR & AOM |
| On Go-around | Descending below DH/DA or MDH /MDA |
| Tracking | Inability to settle within ± 5°<br>Correcting track the wrong way<br>Maintaining an error unreasonably long |

**Engine Fire during take-off**

B777- Engine fire after V1 … edited photo to make a point

**… and if it is still giving power, use it to take you into the air. When safely airborne and at a safe height, deal with the fire with careful deliberation, then clean-up.**

## SECTION 25 - ROTARY WING OPERATIONS

### 25.1 ROTARY WING OPERATIONS - DIFFERENCES

JAR (Operations) Part 3 (JAR-OPS 3), relates to helicopter operations, and was available for implementation by Public Transport operators in the UK in August 1999. JAR-OPS 3 will be law within Europe when annexed to EU Council Regulation 3922/91.

In the UK, the British Helicopter association (BHA) provides guidance to members of the general public on the essentials for helicopter operations.

Information contained in this specialist document *(So you want to be a captain?)* is essentially written for civil commercial passenger and cargo operations. In general terms, some of the contents apply to Helicopter activities. *So you want to be a captain* does not address areas that specifically relate to rotary wing aircraft only, such as training in helicopter flying skills and testing for ability to carry out helicopter-specific manoeuvres such as auto-rotation returns to earth after total engine failure. Notwithstanding, much of the contents of this manual could be of interest to the captain of non-fixed wing vehicles. Pilot Licensing, Aircraft Performance and Helicopter Aerodrome Operating Minima (AOM) differ from those applicable to Fixed Wing aircraft, inter alia.

The helicopter may be used for the carriage of personnel, mainly on large helicopters such as the twin-rotor Chinook for the Military. In the civilian world, helicopters have many uses. They move oil industry personnel to off-shore drilling platforms and to resupply. ‘Choppers’ are also used in the Civil Public Service for rescue, air ambulance, fire fighting, police work and as a private taxi for those who can afford it. They also have agricultural uses such as rounding-up cattle from the air in Australia and elsewhere, crop spraying, logging in Canada, transporting material and installing bulky equipment on the roof of high rise buildings such as air conditioning plants. A heavy-lift helicopter has also been known to lift steeples onto church spires during building.

Trauma Hawk Loading – Palm Beach County FL
Wapedia CCA by Artie Werkle

Bell 205 dropping water - Kern County Fire Dept (Cal)
Wapedia GNU FDL by Alan Radecki

USCG HH-65C Dolphin - Winching
DOD Media USCG PD by M Sgt Rick Cowan

Westland Apache WAH-64D Longbow
Wapedia PD by Adrian Pingstone

CH-54 Sikorsky Skycrane
Wikipedia - US Federal Gov PD photo

RAF Chinook HC2
PD RAF MOD UK photo

## 25.2 HELIPAD/ HELIPORT SURFACE MARKINGS & LIGHTING

Heliports, helipads and other airport areas used for helicopter operations have specific surface markings and lighting that are particular to helicopter operations.

Wiki Commons PD Photo by Joanjoc

### 25.2.1 Equipment

According to aviation regulations on helicopter landing zones, there is certain equipment that must be installed at the location for safety. Every landing zone needs to have a wind indicator that is visible to the pilot in order to allow him or her to better conduct a proper approach. Helipads also need emergency equipment located within reasonably accessible reach to people on the ground, notably a general evacuation and rescue kit and a fire extinguisher. Warning signs are also required near the landing zone to inform people of the purpose of the area and to prevent people from smoking.

### 25.2.2 Markings

Generally speaking, there is little regulation regarding exact markings required for heliports, although mandates require some form of identification. According to aviation regulations on helicopter landing zones, the location in which the helicopter lands should include area markings and any local or state requirements. The majority of heliports are labeled with a number inside of a circle to reference the maximum weight limit of the landing zone, particularly important when a helicopter is landing on a building. For example, a *15* within a circle delineates 15,000 pounds. Hospitals usually use a large "H" designating the landing zone.

### 25.2.3 Landing Zone Lighting

Just like a traditional airport, helicopter landing zones require certain standards for lighting that enable craft to conduct a proper approach and touch-down. Heliports need to have a circle or square of lighting located around the surface of the landing area, designating the exact area in which the helicopter should touch down. These lights used to be officially mandated the color yellow, however, the International Civil Aviation Organization and Federal Aviation Administration now recommend green lights. Both organizations also recommend using LED lights rather than incandescent due to the lifespan of the bulbs. In addition, the landing zone is required to light up the wind cone and also provide general flood lights to help illuminate the surrounding area on the ground.

**Green Helideck Perimeter Lighting:** To be consistent with airfield taxiway edge lighting, all helideck perimeter lighting should be blue. This is not implemented, however, due to the ineffectiveness of low intensity blue lights in the high cultural lighting environment of offshore platforms.

The original specification for helideck perimeter lighting therefore comprised alternate yellow and blue lamps. Around 1990, the specification was changed to all yellow lights to overcome the conspicuity problems caused by the relatively low intensity of the blue lamps. Since the change was made, however, the colouring of the non-helideck floodlights and platform cultural lighting has become predominantly yellow due to the increased use of high pressure Sodium lighting. The resulting lack of colour contrast between the helideck and cultural lighting adversely affects the conspicuity of the perimeter lighting. This causes pilots problems when performing the initial visual acquisition of the helideck.

To address this issue it was decided to change the colour of the helideck perimeter lights to green. Such a change is within normally understood criteria for the colours of visual signals, green generally indicating a safe environment. In practical terms, the colour change can easily be achieved, at low cost, by substituting green filter material for yellow within each fitting. The light output with the green filter in place was found to be sufficient for the purposes of the trial. (See CAA paper 2004/01- Enhance Offshore helideck Lighting – NAM K14 Trials))

Photos Source: CAA paper 2004/01 Lighting - Preferred Trial Equipment Configuration

**The end of a long-haul flight - British Airways B747- 400 about to land**


Wikimedia Commons - PD photo by Arpingstone

**This concludes the general subjects covered in 'Flight Management'.**

**Albatross landing in South Georgia** © 2007 - Captain John C Hutchinson FRAeS

**FLIGHT COMPLETED PROFESSIONALLY WITH A SAFE LANDING AND GOOD DE-BRIEF**

**END OF PART 3 - FLIGHT MANAGEMENT**

## PART 4 – EVENTS AND SITUATION REPORTS (SITREPS)

**CONTENTS**




**The buck stops here …** **© photo by Captain Ralph Kohn FRAeS**

## PART 4 – EVENTS AND SITUATION REPORTS

### PREAMBLE

The art of gaining experience is a solo project that you have to work on by yourself. When you are flying and have a few moments to spare, ask yourself "WHAT IF..." For example, as you approach the Rockies. Ask yourself ”What if I had an engine failure, then mentally complete the recall actions… get the check list out and go through it, quietly and to yourself, then think out the actions.

Ask yourself “What is my drift down altitude? … What is my MSA? “Get your route information manual out, go through it and extract the correct answer. Now carry-on asking yourself questions like

- Must I turn back or can I continue with the terrain clearance?
- Do I have sufficient fuel?
- If I turn back, which is the most suitable airfield to divert to?
- What are the weather conditions at the diversion airport?
- What would I tell the cabin crew?
- When should I tell the cabin crew? … etc,

If the captain is not otherwise engaged, ask him what he would have done in the situation, but NOT until you have completed and made YOUR decision. This will also help you to develop your decision-making.

On each sector you fly, think of something like a medical emergency, a total electrical failure or an emergency descent over high terrain, etc. Combine the QRH contents with the terrain and conditions that you are operating with. By doing this, you will build up a huge amount of experience. If and when something occurs it will not come as a shock, since you have already thought it through. There will be less stress and the job will be completed much more safely.

I once presented a "What / If …" to a trainee captain on Jumbos, when we were on our way to Anchorage on one of his route flying under supervision sectors. The various problems to address surprised him. More importantly, 6 months later this very incident happened to him. He ‘sailed’ through a very difficult situation, because he had already thought it through and had also been through the books associated with this problem.

Because of the reliability of contemporary aircraft and engines that only rarely go wrong, abnormal situations are few and far between. This means that experience previously gained through past exposure to such situations are not part of the background knowledge of the present generation of pilots. They are thus deprived of the fund of know-how that was built by their predecessors, now in command. In this part of this Specialist Document, we will attempt to overcome this loss of knowledge on how best to conduct the resolution of an unusual situation. We will share what we have learned, whether in the air or on the ground, when dealing with the support elements of flight operations, such as ground and maintenance engineers, traffic staff, refuellers, loaders and the myriad of others without whom the operation of aircraft would come to a grinding halt.

To help in overcoming this lack of opportunity to develop one’s own baggage of experience through observation after having been a witness to the decision-making logic of others, be it good or bad, there follows a compendium of Situation Reports (SITREPS) of incidents. These events, as described, are real-life situations that have been experienced by those who have contributed to this Specialist Document. Each occurrence is followed by questions and comments to broaden the field of good and bad practises, to pick from in future use, through events that have happened to others. It is hoped that the thoughts and suggestions offered on how one could best work though problems arising in day-to-day flight operations, will be found helpful in the development of a personal decision-making capability.

**The Situation Reports that follow are from the pen of the following contributors (in Alphabetical order). The ‘Sitreps’ are in no particular sequential order and do not reflect the sequence of the contributors’ list :**

Captain Robin Acton FRAeS, (BA Ret), Captain John M Cox FRAeS (CEO SOS Inc & US Airways Ret), Captain P A F ‘Phil’ Hogge FRAeS (BA Ret), SFO Peter Kohn (BA A320 fleet LHR), Captain Ralph Kohn FRAeS (BAC & CAA Ret), Captain Seamus J P Lyttle BSc CEng FCLIT FRAeS (Aer Lingus Ret), Captain Ron Macdonald (Air Canada Ret) FRAeS, Peter Moxham FRAeS (FOG Chairman), SEO Peter G Richards I.Eng FRAeS (BA Ret), Captain Robert A C Scott FRAeS, (Cathay Pacific Ret), Captain Tim Sindall FRAeS (CAA Ret), Captain P H S ‘Phil’ Smith MRAeS (BA Ret), Captain Dacre Watson FRAeS (BA Ret), Captain Christopher N White FRAeS (BA Ret).

**SITREP 1 – In flight**

**DECISIONS, DECISIONS, DECISIONS**

Occurrence: No. 4 engine fire warning
Aircraft type : DC 8-40, 4 Rolls Royce Conway engines.
Location: Approximately 250 miles North of New York - FL310 - 01:00 Z (21:00 EDT)

The flight departed Miami for Montreal (Dorval) Airport on 28 January 1973. Due to extensive poor weather over Montreal, Ottawa, Toronto and Detroit, Chicago O'Hare airport (ORD) was elected as the alternate airport. This required a heavy uplift of fuel, making the planned landing weight at Dorval close to maximum landing weight.

After discussion with the First Officer (F/O) and Second Officer (S/O) it was decided to descend to FL 250, to burn-off some fuel (approx 7000 lbs) as we were well ahead of our planned fuel burn, to reduce our landing weight, due to the weather and the 500 feet 'limits' for an ADF approach. Dorval weather was reported as 500 feet overcast, visibility 1 to 2 miles, light freezing rain and the wind from 320 to 340 degrees 35 knots gusting to 45. This meant us having to use the 7000 feet Runway 28 via an ADF approach, giving a strong crosswind component.

After levelling at FL250, a fire warning light and bell came on for No. 4 engine. I called for the memory items of the fire drill, calling each item for No. 4 engine and to our relief the fire indication ceased. I then asked the F/O to fly the airplane while the S/O went through the full engine fire drill with me.

After about 4 minutes the No. 4 fire bell and warning came on again so the second bottle was discharged but to no effect. This now left the right wing and No. 3 engine with no fire protection. The three of us discussed as to what may have caused the Fire Warning to come back on again and we agreed there must be some high heat or maybe burning somewhere inside the cowling.

With still another 45 minutes to go to a landing at Dorval and with the fire warning light still on, I made a PAN, PAN, PAN call to declare an 'Urgency' situation. Shortly afterwards I saw the fully lit 12,000 feet runway at the Strategic Air Command Base at Plattsburgh (PLB) New York, through a break in the clouds and decided to land there, for the safety of the flight. I told the F/O to handle the airplane while I contacted the SAC tower, explained my situation and requested an immediate landing. I was given a descent clearance and permission to land ASAP.

I advised the purser we would be on the ground in 10 minutes, explaining that we had a problem and to get the cabin ready for landing, with a possible evacuation.

After landing I shut down Engines No. 2 and No. 3, leaving No. 1 engine running to restart 2 and 3 if no actual fire existed (I also had to be able to get off the runway in case there was a SAC scramble). The fire chief called the cockpit through the ground to cockpit connection and said that all was clear, that there was no evidence of any fire and to get off the runway ASAP. I re-lit engines 2 and 3 and cleared the runway while the S/O advised the passengers to remain seated and that the Captain would soon make an announcement. After shutting down the engines on the ramp and explaining to the passengers "where they were and why", I was called to the airport transit office where there was a 6-way conference phone call from the US NTSB wanting to know what had occurred and why I had landed at the PLB SAC base.

When I had completed explaining my actions, that is a repeat fire warning that remained ON after all extinguisher bottles had been fired, Dorval weather at minimums, freezing rain and facing a non precision approach (ADF) in strong cross winds, they congratulated me on my decisions. Next day company maintenance arrived with 2 new fire bottles, did a check of the engine and components then cleared the airplane for a ferry flight to Dorval, which I operated.

A hearing was held on why I had diverted to the PLB SAC USAF air base. I again gave the same explanation I had given to the NTSB but a senior maintenance representative said I should have considered it as a false warning (which maintenance were still convinced it was). So I asked him what the purpose of the engine fire warning system was and whether I should always assume such warnings as false and ignore them.

During the hearing the NTSB telephoned and advised the company that they fully supported my decisions on the emergency landing, so maintenance shut-up. The same aircraft was put into service that night on the Montreal to Paris, Orly (France) service when, during the noise abatement power reduction, the fire warning came on once again for No. 4 engine. The captain was unable to extinguish the fire warning and he elected to return to Montreal immediately, for a rapid overweight landing. The aircraft was taken to a maintenance hangar where a crack was found in the high pressure turbine area, leaking red hot air and thus triggering the designed fire warning system as planned.

During the entire incident I utilized the knowledge and skill of both the First Officer and Second Officer to arrive at my decision to land as soon as possible. In my day I suppose you called it airmanship. Today it is called CRM.

**QUESTIONS**

1. What would you have done in this situation – if different WHY?
2. Why did the Captain hand control of the aircraft to the First Officer?
3. Would you do the same in all emergencies?
4. If yes … Why? … If not, why not?
5. Would a MAYDAY call have been more appropriate?
6. How would you have handled the ground engineer?

7. What would you do in future, if the Technical Log says ground checked found serviceable?
8. What does the law say about accepting an aircraft for a flight?
9. When would you take “matters” further, that is to the Management or even the Regulatory Authority?
10. In what order would you approach the above.
11. Why would you be taking “matters” further?

**WHAT CAN ONE LEARN FROM THIS?**

1. The decision to land as soon as possible and at the nearest aerodrome, after a fire in the air incident is the correct one. The best place to deal with an aircraft fire is on the ground. In general, aircraft that are landed after an aircraft fire and evacuated in good time have a high survival rate, as very many such ‘fire in the air’ incidents indicate.
2. Note that The First Officer was asked to fly the aircraft (***‘Mind the Shop’***) whilst the Captain and Second Officer dealt with the emergency.
3. The ground engineer who said that the captain should have completed the flight normally because he felt the warning was spurious was clearly wrong. He did not even offer information on any maintenance trouble-shooting action after the event upon which this opinion might have been based, after the two spent fire bottles were replaced. The possibility that the nacelle fire-wire detection system was at fault seems to have been ignored and no tests were seemingly carried out to eliminate that reason. The Maintenance department was clearly remiss in its post-incident actions.
4. Do not be pressurised into accepting an aircraft in situations where a ground engineer, who wants to get rid of the aeroplane for an on-time departure, is prepared to release an aircraft for expediency, with ‘carried forward’ systems’ faults that should be cleared, particularly at ‘Base’, where all such faults are supposed to be cleared.

**COMMENT**

Maintenance Engineering responses to some technical log entries, with no maintenance action other than a “Ground checked and found Serviceable”, are not good enough. If something is reported as faulty in the air, then checked on the ground and found to be working normally, then more investigation is clearly necessary. In the case of the DC8 in this ‘Situation report’, the aircraft seems to have been programmed for a flight to Paris with no further investigation. The consequences for this were that not only was No. 4 engine found to need attention, but an additional time-consuming overweight landing check had to be carried out, after an unnecessary immediate return to the departure airfield that could have been avoided had more searching trouble-shooting been done after the first incident.

---

**SITREP 2 – In flight**

**HUMAN FACTORS AND THE ART OF FLIGHT DECK MANAGEMENT**

This story is an account of a series of events that challenged the whole crew of a Boeing 747-236 'Classic' aircraft variant. The route was a long day's flight from Gatwick to Houston, Texas, commencing at the benevolent hour of 10:00 am. The overall Flying Duty Period (FDP) was some 11 hrs 50 minutes and thus well within the permitted FDP 'rig' for a 3-man crew. The story starts with the Flight Engineer's external 'walk-around inspection' and the minor defect he encountered.

The B747-236 is a large and highly evolved 'basic aeroplane', enjoying a huge flight range with massive commercial loads. To enable these quantities and dimensions, the designers provided a Landing Gear system of 4 Main wheel sets and a set of Nose wheels equipped with steering, with their hydraulic supplies divided between 2 hydraulic systems. The aircraft has four Rolls-Royce RB211-524D4 engines and each engine drives a Hydraulic system. No 1 system feeds the Inboard Main wheels for extension and retraction and also provides the Nose Wheel steering, Alternate Hydraulic Brakes and the hydraulic muscle for the Inboard Flaps too. No 4 system feeds the Outboard Main wheels, the Outboard Flaps and Normal main normal wheel braking system. Both sets of flaps also enjoy the provision of a back up or Alternative Electrical system. There is thus an immense level of redundancy.

During the external check, the flight engineer noticed a slight hydraulic leak on the left hand Inboard Main wheel bogie 'Down' lock actuator and drew this to the attention of the ground engineer, who was also doing his departure inspection and refuelling the aircraft. As a professional engineer, the flight engineer also made the journey up to the flight deck to advise the Captain of what he had found and to keep both him and the Co-Pilot 'up to speed', that there might be a short delay while this leak was corrected. The Captain became very anxious about the delay and the effect on the flying duty time and told the flight engineer "Not to interfere".

Some time later, it became apparent that the leak was proving troublesome and a replacement actuator was requested. While this was being 'chased', further work by the ground engineers seemed to cure the leak and a leak check, made by all engineers including the flight engineer, confirmed by applying 3000 psi - the normal system pressure, to the actuator, that 'held the pressure' to the satisfaction of all. All this delay had 'eaten into the Duty time' a little but sufficient time remained to fly the aircraft to destination. The Load sheet came and disclosed that the aircraft would be at maximum permitted weight for the runway and conditions and the consequence of the full load meant that only the bare minimum Flight Plan Fuel could be loaded, with no additional permitted, in spite of a poor weather forecast at destination. After detailed scrutiny, the Captain signed the Load Sheet, so then they were ready to go.

The rest of the departure proceeded without any further hitches or delays and they commenced the Take-Off roll. As the aircraft left the ground, the routine call by the Co-Pilot was "Positive Rate of Climb", to which the Captain's routine response was "Gear Up". The Co-Pilot selected the landing gear up and simultaneously, as the Down Lock released, the previously suspect actuator split open and although the landing gear retracted and their associated wheel well bay doors closed, hydraulic system No 1 was rapidly lost, with the system pressure of 3000 psi behind it.

The aircraft was not in any particular danger; as the landing gear, a major source of drag, was now retracted; determined by all the necessary indications. The Flight Engineer called the Hydraulic failure at which point the Captain turned around and spat in his face, calling him a " You Stupid...(expletive).!. Somewhat taken aback at this form of command presence, the flight engineer, as calmly as possible, wiped his face and said "Be that as it may, we still need to clean up the aircraft and complete the After Take-off checks, … sir".

The Captain barked out the commands and the Co-Pilot and the Flight Engineer completed the necessary checks, including retracting the Inboard Flaps by the Alternative Electrical system. With the heavy weight of the aircraft and the relatively slow progress using this alternate system, this required some very precise speed control by the Captain, to ensure that the flap configuration against speed 'gates' were maintained. Practicing doing this is a simulator routine that all aircrew demonstrate competence to achieve.

Composing himself to the best of his ability, the flight engineer was quickly working through the ramifications of the loss of the No 1 Hydraulic system, with the aid of manuals and checklists provided for these sorts of events. Satisfying himself that he could deal with everything, he turned to the Captain and asked him : "Would you like me to go through the ‘Loss of No 1 Hydraulic System checklist’ with you; Captain?" and receiving a grunt of affirmation, suggested handing over control to the Co-Pilot, so that the captain could give his undivided attention to the task. He read the checklist and confirmed that indeed all the No 1 system fluid had been lost. With that the Captain snapped his copy of the checklist shut and turned to pay more attention to the route ahead and some Air Traffic Control instructions.

"What are your intentions, Captain?" asked the flight engineer. "We fly to Houston" responded the Captain. "Are you sure that this is the wisest course of action?" the engineer replied. "What do you mean?" snapped the Captain. "Did you read the small italic note on the bottom of the Checklist page about this particular hydraulic loss?" the engineer politely asked. "Give me the f***ing book again" was the response. The Captain spent a few seconds re-reading a page he had read many times, without apparently absorbing the information on it. "What does this mean?" he shouted, pointing to the italic note, which read 'Loss of No 1 or No 4 hydraulic system may lead to the loss of the Transponder Altitude Mode C signal'. Or in plain English, the air traffic 'flight identification signal' on the radar screen would no longer have the encrypted height of the aircraft as part of that 'radar return'. This would mean that Air Traffic Control would not know the aircraft height automatically and would need to ask or be told this every minute or so of the flight.

"Does that matter?" asked the Captain, to which the engineer replied, "In theory 'No' as we have left the ground, but I don't know if the USA will let us into their airspace without Mode C". The reason for this lost signal is that the landing gear, although safely stowed inside their stowage, known as wheel wells, is held in its position by a hydraulic lock. Without that 'lock', the Inboard Main and Nose wheels will eventually 'relax' and literally rest on the closed doors beneath them. This very small movement can be enough to 'translate' the landing gear 'logic' from 'flight' to 'ground' and, as the Mode C height read out signal is not required on the ground, it is disabled. Other systems affected by this changeover included Pressurisation control and the Pitot/Static mast heaters, so Icing Conditions would need to be avoided too.

By now the Captain had modified his behaviour a bit and was becoming more manageable, so the engineer ventured the following probable sequence of events. "We can fly like this until the Air/Ground logic changes over and then somebody declines to accept us. We will have to then avoid icing conditions at all times and run the pressurisation in 'Manual'. We will have to deal with that as it happens and if we have to land at some other place, then we will have to wait for either a spare part or some rectification, as it may not be the same component that we were working on before. As we approach Houston, given the poor weather across the US Mid West, all the way south from Chicago, we will be, by then, reduced to minimum fuel, according to the flight plan.

This plan is based on the flight profile of the aircraft remaining 'clean' for as long as possible during the approach. We will not be able to do this as we will have to both lower the Flaps electrically and then release the Nose gear and Inboard Landing gear electrically and hope they unlock and deploy like they do in the simulator. We will have to do this many more miles away from Houston than normal to ensure that we have enough time to correct any further problems, thus increasing our fuel consumption.

We will all be at least 11 hours more tired than we are now and if we have got that far, will still have to remember to tell ATC our height, every time we transmit our position. It is the 'avoiding of Icing conditions' that worries me the most. Any questions or differences of opinion on what I have just told you?"

"S**T" said the Captain, "What do you think, Co (co-pilot)?"; "Well Captain, this is the first time since we left Gatwick that you have included me in any of this and I am not happy to go on to Houston".

"B*****ds" shouted the Captain, "OK, back we go. I have control. Negotiate a place we can dump fuel and get on to the company to organise our return." "What weight do you wish to land at, Captain?" asked the flight engineer. "Make it 265 tonnes, as I don't fancy handling maximum landing weight (285 tonnes). Oh and by the way. I am an ace at steering the 747 using differential braking, as I tried it last week in the simulator."

So they dumped 80 tonnes of kerosene over the Channel at 20,000ft and began their approach to 'Gatwick via Mayfield'. No sooner had the descent commenced when ATC started asking "XXX we've just lost your Mode C. What's your height?" Stifling a smirk of relief and satisfaction, the flight engineer read all the checklists and provided the landing weight speeds for the appropriate flap selections. He went through 3 routine or normal checklists for Descent, Approach and finally Landing, together with 6 Non-Normal checklists for loss of Hydraulics (review), Alternate Landing Gear, Alternate Flaps, Alternate Brakes (Not available but review anyway), Loss of Steering and Emergency Evacuation and methodically briefed the Captain as every checklist was complete. The Cabin Crew were given an emergency landing briefing as a precaution for a possible Evacuation for a Landing Gear failure or a Brake Fire. Between them the two pilots flew an immaculate approach and the Captain's landing was 'text-book'. He vacated the runway using differential braking, as briefed, coming to a standstill at a convenient point to enable the emergency services to surround the aircraft to manage any hydraulic vapour fire from the fluid drenched brakes. There were clouds of smoke but no fire and no need to evacuate the aircraft after all. They were towed to a parking stand and ground staff took over from then. The 'Incident' was the subject of much report writing, but after about another hour, the crew were allowed to 'stand down' and go home.

Job done? … Open to debate. Several days later, the flight engineer received a telephone call from one of the technical managers in 'the office'.

"Air turn-back and fuel dump following a single hydraulic system loss. How did that happen?" was the succinct, but challenging query.

"Have you spoken to the Captain about this incident?" the flight engineer responded.

"As it happens, we haven't yet, as he is away again on duty and we wanted your point of view".

"The decision to return must have been made by the Captain, but I suggest you talk to the co-pilot too. Technically, all the drills and responses went according to Standard Operating Procedures, although the Captain has a singular style of management." The engineer replied. There the conversation ceased and the engineer breathed a sigh of relief.

**QUESTIONS**

1. What would you have done in this situation – if different WHY?
2. Should the Captain have handed over control of the aircraft to the First Officer?
3. Was there ever a group discussion about the problem?
4. Would this have helped the commander to gain more information?
5. Why did the Captain not involve the First Officer in the discussion?
6. Remember Part 3 the Images of a good commander?
7. When a commander starts to swear at the crew is there a problem? If so what?
8. Would you do the same in all emergencies?
9. Should the First Officer have spoken-up earlier?
10. If Yes, Why? If No why not?
11. How would you have handled the flight engineer?
12. This could have been a ground engineer, how would you have set about it?
13. What would you do in future, if an in-flight problem such as this occurs?
14. What does the law say about accepting an aircraft for a flight?
15. When would you take “matters” further, that is to the Management?
16. Was this event reportable to the Regulatory Authority? If yes, by what means?
17. In what order would you approach the above?
18. Why would you be taking “matters” further?

**WHAT CAN ONE LEARN FROM THIS?**

1. Clearly, it is important to know the technicalities of your aircraft in depth. It is an obvious corollary to this unfortunate episode of poor leadership and abysmal crew management style.
2. One must also comment on the total lack of good manners and the surprising low level of essential technical knowledge from the part of this Captain.
3. As a participating crew member, it is vital that you tactfully speak your mind if ever faced with a clearly unacceptable decision.
4. The Flight Engineer must be commended for his restrained response to a clearly confrontational situation and for his self-controlled professional approach to the cascading technicalities of the situation. It was most resourceful and wise that he should involve the First Officer in an indirect manner by directing to the captain the question: *“Any Questions or differences of opinion on what I have just told you?” This spread the load and reduced the focus of antagonism from a Captain who was not in command of the situation, as he should be.*

**SITREP 3 – In flight**

**MISGUIDED? … OR MISUNDERSTOOD RISK-MANAGEMENT?**

The Boeing 747 'Classic' variant has been the Long-haul workhorse for many airlines for over 35 years. It is a marvel of integrated systems, all under direct human control, with enormous redundancy, together with a level of automation that can reliably deliver an Automatic Landing in very low visibility. The crew is composed of a Captain, a Co-Pilot and a Flight Engineer.

In the incident under this heading, the Flight Engineer was in fact the most 'senior' member of the crew, as he had been flying for over 25 years including 12 years on the B747. But the Captain of course is the Commander and she was fairly new to this position, having taken her command course option on to the 747 after a long period on much smaller aircraft. Likewise, her co-pilot had little time on the fleet and the wide competence spectrum of Flight Engineer's abilities didn't feature on the conversion course.

The Flight Engineer was permitted and often encouraged that, when time and the operational situation permitted, he could leave his seat and go into the cabin to rectify any minor defects that might have arisen over a flight lasting 10 hours in some cases. There were frequent calls by the Cabin Crew for the In-Flight Entertainment to be 'repaired', as the seat-seat inter-connector wiring depended on continuity between some electronic boxes located just underneath the passenger seat pan. This location made them vulnerable to damage, especially from children between the ages of 7-13, during which time their heels would easily swing on to the electronic box cover and literally smash this to bits. Nowhere in any advice to the passengers was there any advice to remind parents to keep an eye on their children to prevent this! There were other faults he could fix, such as the intermittent failure of Hot Cup sockets, or the re-setting of galley 'Chiller' controls if they had tripped out due to prolonged use and over-heating.

Toilet wash hand basin water heaters have a built-in re-settable thermostat. Toilet flush motor systems would sometimes trip out too, from inadvertent contamination from passengers 'losing things' or attempting to dispose of nappies. The circuit breakers for these were located in the Electronics bay below the First Class Cabin galley and could be accessed by a trap door in the cabin floor. There was even a 'designated procedure' for this access, as for a short while, there would be a large hole in the cabin floor and this needed to be 'guarded' by a cabin crew member to prevent any passenger from falling down there, especially if access was required during the night..

Receiving a call that the mid section toilets had stopped flushing, the engineer volunteered to go to the scene, assess the conditions and if he was satisfied that a reset could safely be made, make one attempt to restore this vital passenger service. So he made arrangements on his Flight Engineer's panel such that it would be safe to leave for a few minutes and turned around to brief the Captain about what he proposed to do.

To his amazement, this proposal was rejected immediately and so the engineer enquired why this simple task to restore a passenger amenity could not be carried out.

"What would we do if, while you were down there, we had a Pressurisation Failure or an Engine Fire?" asked the Captain. "How would we get you out if, while you were down there you became incapacitated?"

Dealing with these, albeit reasonable, queries, the engineer thought for a moment and then replied "If I thought I was going to be incapacitated, I wouldn't go down there, but the way I feel right now, I would bet my life will last until I have done the job I wish to do. As for the Engine Fire, you two have had to prove on your conversion course that you can manage that long enough for me, or a cabin crew member, to get back up here to complete the drill and read the checklist. The Pressurisation question, the way you put it, is a stopper, I agree and that is a risk I have lived with for over 25 years of leaving my seat and going around the aircraft to fix things. How's about I take one of the portable oxygen cylinders and a mask, that the cabin crew use for sick passengers, down there with me?"

"No. You stay at your panel and that is that" responded the Captain.

The engineer reluctantly called the mid-galley and advised them that their nearest toilet block would not be restored and that if this would be a problem with 356 passengers on board, to come and discuss this with the Captain. Sure enough the Cabin Services Director arrived in seconds and received a similar polite but firm direction that the Flight Engineer could not be permitted to leave his seat to attend to this.

It was the only time in 27 years as a Flight Engineer; I wasn't allowed to do my job. From talks with people on the Airbus stand at the 2004 Farnborough Air show, it seems that a level of 'technical expertise' will be required in the A380. One wonders what they will call the person(s) that are needed for this?

**QUESTIONS**

1. What would you have done in this situation – if different WHY?
2. What "Mode" was the captain in? See Part 3 – 7 behaviour.
3. If this happened to you, how would you endeavour to change the behaviour of the difficult person?
4. Do you know why the captain refused the flight engineer's request?
5. Had the captain given any thought to the passenger welfare?
6. How important are passengers or are they human cargo?
7. Was it a lack of ability to delegate?
8. If yes, how would you be certain not to find yourself in this situation?

9. Is it important that the aircraft commander is technically competent on all aspects of the aircraft?

**WHAT CAN ONE LEARN FROM THIS?**

1. Was this Misunderstood Risk Management? ... leading to
    a. A misapplication of the decision mode with,
    b. Inexplicably confused logic – which meant that for the remainder of the trip,
    c. The loss of Major passenger amenities on a very full aircraft, possibly needlessly.

**COMMENT**

The co-pilot was neither involved in the decision-making process, nor did he venture an opinion on the advisability to deny the use of the toilet for a specious reason.

---

**SITREP 4 – On the Ground**

**THE HUMAN FACTORS AROUND A FERRY FLIGHT**

In this incident, a crew have successfully dealt with a combination of Loss of Pressurisation, caused by a cargo door seal bursting at 37,000ft, followed shortly afterwards by Smoke of Unknown Origin. During the initial part of the Emergency Descent, the Captain had briefly become incapacitated, as his oxygen mask had partially failed and thus he could not participate in all the numerous drills or respond to checklist calls. The failure was in the elasticised harness not being able to keep the mask over the Captain's face.

The aircraft is a Lockheed Tristar L1011-200 and the flight is over India, with an Emergency Landing diversion into Calcutta following the incident, instead of 'pressing on' to their scheduled destination, Dhaka. The crew accommodation in Calcutta was in a very sub-standard hotel and they did not really benefit from the rest facilities provided. Following some ingenious maintenance to repair the damaged door seal, the cause of the Pressurisation problem, the crew were asked by the Fleet Technical Manager by telephone, to 'ferry' the aircraft at low level from Calcutta to Bahrain, where better maintenance facilities could be utilised. The flight crew immediately agreed to this request and set about gathering the Cabin crew to seek their opinion about coming along with them. The Tristar crew consisted of a senior Captain, a Senior First Officer and a Senior Flight Engineer Officer. In those days, trips could be away from Base for two weeks or more at a time.

The low level ferry flight could only be made below 12,000ft, as there was insufficient crew oxygen remaining, both for the flight crew and the passengers (the nine cabin crew), to fly any higher. In addition, the jury repair to the cargo door seal could not guarantee pressurisation at anything above 2 psi differential pressure, barely enough for the demands of the Electronic Equipment Cooling.

Flight planning for such a flight during the May South-West, monsoon season, also required that the aircraft be kept as close as possible to runways capable of an Emergency Landing. The source of the 'Unknown Smoke', although it had cleared quite rapidly, could not be identified away from Base. So we planned a series of 'dog legs' between major cities across India, thence to Karachi, then to Muscat and then finally into Bahrain. This meant that a considerable extra distance would need to be flown. Constraints within the aircraft Flight Envelope meant that the airspeed would be very much reduced.

Throughout this somewhat risky flying duty, the Captain used his considerable personality to reassure the cabin crew and his colleagues on the flight deck. At every stage, or Waypoint, the flight engineer would do a full systems scan and then the Captain could propose that 'pressing on' would be safe, as the smoke did not re-appear, although the flight was quite turbulent at the level. In addition, the demands of Equipment Cooling in the high ambient temperatures meant that the majority of the Cabin lighting became de-activated.

On arrival in Bahrain, the aircraft was handed over to the maintenance engineers, so that a proper door seal could be fitted and a specialist management crew had been ferried out to Bahrain to fly the aircraft back to the UK, so that the UK Air Accident Investigation Branch could determine the cause of the smoke. The whole crew were highly relieved to have achieved this Non-Standard sector and as they hadn't had much quality rest or opportunity to 'wind down' from the previous Serious Incident sector, felt a short break might be permitted.

A party was convened in the Captain's suite and after a few hours, the flight engineer went to his room to get some sleep. He had only been asleep for about an hour when he was awakened by the telephone message light flashing, about one foot from his eyes. He picked up the message to learn that he would be woken up by the hotel in three hours so that he could be positioned to another city in the Gulf, to operate a disrupted service, following a minimum period of six hours rest at the 'new' city. Calling the airport Duty office, he advised them that he would not be complying with this request, as he had not, until that time, had any access to a doctor – a routine requirement following a Pressurisation failure. The engineer then got up and went back to the now much diminished room party and told the Captain what had happened.

The Captain then took Command of this situation and called the airport from his room, to advise them that the whole crew, both flight deck and cabin would need to see a doctor and that they, the airport staff, should be organising this for the following afternoon. The airport staffs were very angry and demanded a reason for failing to acknowledge a duty.

To this the captain responded that in his professional opinion, the crew had had such poor quality rest following a seriously traumatising duty, that the least they could accept was 24 hrs free from any further duties. He would be taking the whole crew to an Aero-Medical Examiner and the doctor's professional opinion would be sought.

The doctor examined all the crew and promptly determined that they were all so 'shell shocked' in his opinion, that they should not be re-rostered for 7 days. He made an exception for one of the cabin staff, who had leave booked for two days hence and allowed her to passenger home. The doctor called the airport from his office to advise them immediately.

**QUESTIONS**

1. What would you have done as the captain in this ferry-flight situation? If different, … what and why?
2. Was the Flight Engineer wrong in refusing the instruction to get out of bed, position to another station then fly without the agreed minimum rest?
3. Was the Flight Engineer correct in reporting the matter to the captain?
4. If Yes, why? If No why not?
5. How would you have handled the outstation staff-member telephone call?
6. What would you do in future, if a rostering problem such as this one occurs?
7. What does the law say about flying whilst tired?
8. How conversant are you with Company orders?
9. When would you take "matters" further, that is to the Management?
10. Was this event reportable to the Regulatory Authority? If yes, by what means?
11. In what order would you approach the above?
12. Why would you be taking "matters" further?

**WHAT CAN ONE LEARN FROM THIS?**

1. Operationally speaking, this aircraft-positioning ferry-flight was carried out efficiently by a well motivated crew, led by a competent captain. All rose to the occasion and dealt with an abnormal situation in a very professional way.
2. Command Leadership presence is not just exercised on the flight deck but also away from it too; where the crew as a unit needs to be considered more as a family than mere numbers on a roster.
3. A 'weaker' commander might have accepted the extra duty and the consequences of that, hard to imagine.
4. Individuals need to know their limits and Captains need to accept these, even though they may sometimes fall foul of company expectations.
5. The Company crew-rostering department should have been aware of the situation the crew was in after their disrupted trip and ferry flight. They nonetheless 'tried it on' for expediency, as an easy way out of whatever predicament they were in, that required a replacement flight engineer at another station.
6. The Flight engineer was quite within his rights to refuse to comply as he would have started his proposed next operation without having had adequate rest after interrupted sleep, followed by a positioning flight and then less than agreed 'minimum rest' before having to report for his next duty.

**COMMENTS**

1. Know your Rest, Duty and Flight Times limitations agreement accepted by both Company and the Regulatory Authority.
2. Do not be pressurised by the Rostering Department into accepting an assignment if this breaks the agreement. Airport staff are merely their mouthpiece and their expressed anger at not being obeyed, should not be taken into consideration.
3. Rostering Departments, are very good at 'sob stories' which usually include the words : "You would do us a great favour which we will not forget" and "You are the only person we have to-day who is able to do it". You can bet your bottom dollar that if you say NO, someone else will be found and the flight will not be grounded for lack of a crew member.
4. Fleet Managers might want an explanation as to why the instruction was refused. Know your rights and do not be intimidated.
5. The captain supported the Flight Engineer and made sure that all of his crew was protected from further duty whilst in an inadequately rested, tired condition.
6. A Captain's authority starts when she/he reports for duty before a flight when the names of the flight deck and cabin crew members for the programmed service(s) are known.
7. Command Authority ends when the crew has returned to base at the end of the rostered period, after crewmembers leave the aircraft and disperse following the completion of the flight, having filed all post-flight reports as required. When down-route, if all the crew does not remain the same for the whole rotation, command authority over the crew is assigned to the new captain on transfer. Responsibility is assumed for new crew members joining the captain downline upon notification of the change.

**SITREP 5 – On the ground & in flight**

**THE MANAGEMENT OF PERSONALITY CLASHES**

**A.** In this first incident, a combination of a Junior Captain, a very Senior First Officer who had failed a Command Conversion course and thus precluded from Captaincy, and a Junior Flight Engineer Officer who was still in his first year as an E/O, made a routine flight a nightmare. There is a code of procedure in some companies, whereby newly created Captains cannot give sectors to their Co-pilots until six months have elapsed since their rank of Captain was confirmed. The aircraft was a Boeing 707-436 and in addition to the Flight Deck Crew, there was a cabin crew of six.

The crew were advised that the flight was a charter for the ferrying of Chinese restaurant staff, between London to Hong Kong, via Dubai. This charter was so frequent that one of the company aircraft was dedicated to the route and had even been repainted in the charter company colours. The Cabin crew, of ethnic origin, would be supplied by the charter company.

The First Officer had arrived at the briefing point well ahead of the required time and had gathered all the necessary paperwork for flight planning. From the very first exchange between the two pilots, the flight engineer realised that personalities would play a major part in the success or failure of the flight. Without any explanation, the captain brazenly told his Co-Pilot, “I’m doing both these sectors” without any explanation as to why. The style of the captain’s voice was such that the Co-Pilot was clearly taken aback and, being many years older than the Junior Captain, responded with a stream of invective, the cleanest part of which was “Suit yourself”.

Having decided the fuel requirement, the crew were taken to the aircraft and the flight engineer commenced his external inspection. All was well with the technical state of the aircraft and so he made his way on to the flight deck to commence his internal pre-flight checks. He became aware of the icy atmosphere between the two pilots, but being very junior himself, did not feel he could contribute much, other than to be totally professional, while ensuring that if a checklist response was required, that whoever should respond, having done or checked something, that this had been carried out before saying so.

The engines were started and the ‘Taxi Checks’ commenced, with selections of flap and the setting for the Trim. The Engine Anti-Ice system would be necessary and the Flight Engineer liaised with the captain to ensure that all the engines had this system functioning correctly. All checks being completed, the aircraft lined up to take off.

On the Boeing 707, the airspeed indicators are duplicated and there is a standard call out required that, during the early part of the take-off run, that these gauges are actually reading and that any differences between them acceptable. This call is usually made at around 60kts, as this is the lowest speed that an accurate value can be given.

The speed built up and the flight engineer noticed that both the airspeed indicators were indeed showing a rising airspeed. The Co-Pilot remained silent and after 70kts had been passed, the Flight Engineer could not resist commenting “I see that the Airspeed Indicators are reading, both sides and no discrepancy”

“That’s my call” shouted the Co-Pilot.

The Captain took his hands off the engine thrust levers and punched the co-pilot on the upper left arm, while shouting back “Well f*****g make it then!”

By then the speed had increased to a critical speed and the routine call by the co-pilot should be “V1”, which is the speed beyond which any emergency on the runway must be taken into the air, as insufficient runway remains to stop in.

“V1” shouted the Co-Pilot, but 5 knots late. He called “Rotate” at the correct speed and the Captain gently and professionally raised the nose and the flight was on its way. The next call to be made by the co-pilot should be “Positive Rate of Climb” to which the captain should say “Gear Up” and these two calls take place around 100ft above the runway. Passing 100ft and no call was made by the co-pilot, so the flight engineer, thinking that something seriously wrong was going on, called “I see we have a Positive Rate of climb Captain”. To which the captain ordered “Gear Up”.

“Put your own f*****g gear up” came the response, but the captain felt some turbulent air penetration, possibly from the departure wake of the previous aircraft and so he had to keep both hands firmly on the flying controls. So, recognising the enormous performance drag of trying to climb with the landing gear still extended, the Flight engineer offered to do this for the Captain to be told to “Shut up. Do your f*****g job John, or I am dumping fuel and going back”. Reluctantly, it seemed, the co-pilot selected the Landing Gear to ‘Up’.

The rest of the flight was carried out in almost total silence unless one or other of the pilots was off the flight deck, in which situation, the remaining pilot would harangue the poor flight engineer about the inadequacies of the other.

How do you cope with a Commander from Hell? The hectoring style of speech and the insensitive handling of a ‘difficult’ co-pilot could so easily have caused an accident. Could the flight engineer have done anything else? Over the years, the flight engineer flew with this Captain three times and on each occasion, something would ‘go wrong’ that needed a Command presence, to which this captain almost certainly introduced more drama than his more normal colleagues would have done. Twenty years have now passed, during which time the flight engineer and the Captain have met briefly only once. However the dominant dimension of the Captain’s personality has not changed.

**B.** Another example of problems caused by such a ‘hectoring’ style caused a young co-pilot to totally lose Situation Awareness on descent into Rio where he followed the wrong Heading, that had been wound on to the Heading cursor by the Captain, who had made a simple human factors error of transposing two digits in his mind, when accepting an ATC instruction. The flight engineer had written down the ATC heading and intervened to correct the Captain, showing the Captain his clipboard, only to be ignored and then reluctantly querying with ATC. By this time the aircraft was heading straight for high ground and ATC were getting very alarmed, cancelling further descent and issuing a rapid series of heading changes and speed controls to avoid a CFIT accident. The young co-pilot got very anxious and lapsed into a sort of robot mode and it took a lot of effort by the flight engineer to keep him engaged.

**QUESTIONS**

1. What would you have done in the first situation – if different WHY?
2. Should the Captain have given the co-pilot a handling sector and offered him the choice?
3. What of the First Officer's behaviour? Should the captain have remarked on it and done something about it when the first 'explosive' tirade occurred during briefing?
4 If Yes, Why? If No why not?
5. How should the flight engineer have reacted to such a poor verbal interplay between captain & co-pilot from the beginning, to avoid it developing into a quite dangerous situation?
6. What would you do in future, when you are on a multi pilot crew if a problem such as this occurs?
7. How would you cope with someone much older and perhaps even more experienced?
8. Having newly joined the company as a more mature First Officer from the Air Force, this could happen to you. When and how would you handle the situation?
9. Who would you turn to for advice on what to do regarding such pilots?
10. When would you take "matters" further, that is to the Management?
11. Was this event reportable to the Regulatory Authority? If yes, by what means?
12. In what order would you approach the above?
13. Why would you be taking "matters" further?

**WHAT CAN ONE LEARN FROM THIS?**

1. In the first part of the 'Sitrep', the relatively junior captain appeared to be particularly abrasive in his attitude towards the older co-pilot
2. This captain seems to have maintained this abrasive attitude throughout his career.
3. The co-pilot was particularly obnoxious and had a distinct personality problem that was bordering on the dangerous.
4. In the second example of this Sitrep, the captain's error in transposing numbers in an ATC instruction was a human failing. That he refused to acknowledge the Flight Engineer's attempt at correcting the mistake he made was appalling airmanship. So was his behaviour and treatment of his young inexperienced co-pilot.
5. The Flight Engineer did his best to keep the co-pilot focused on his flying of the aircraft and to stay away from terrain and a CFIT situation.

**COMMENTS**

1. No one seems to have picked up this captain's Attitude Problem towards his colleagues. Was this a failing of the training department that 'rubber-stamped' recurrent check flights and route checks from the start of his career in the left hand seat?
2. The abrasively abrupt manner he used to deal with his older co-pilot pre-flight when he told him that he (the captain) would fly both sectors, then did not deal with the situation he had created when the co-pilot responded in such violent language, should have been a warning that a big problem was developing. That he did nothing to defuse the situation at that point only allowed the situation to further deteriorate as the flight progressed. The captain should have explained that because he was a recently promoted captain, the rules did not allow him to give sectors to co-pilots; and that he was also not to be rostered with others who had been on the fleet for less that a given period. These are UK Regulatory Authority requirements that are explained in the Guidance to AOC holders' documents, which operators are expected to adopt and abide by; and upon which Operations Manuals are compiled.
3. The captain's body language during take-off and his way of responding to the co-pilot's unacceptable responses were not helping to return the atmosphere to normal.
4. The co-pilot was totally unprofessional and downright dangerous by acting as he did after take-off and thereafter.
5. The captain clearly had a communications problem when dealing with his crew.
6. The first officer's attitude left a lot to be desired. He too had an attitude problem that seems to have been overlooked by fleet management, allowing him to continue to operate whilst in such a disturbed frame of mind brought about by frustration and jealousy. It is probable that he saw failing his command course as everybody else' fault except his own; a fact he was unable to accept, resulting in the sort of unreasonable behaviour demonstrated.
7. To go on a Command course in BOAC in the early 1970s, was a 'once in a lifetime' thing and if you failed to make the grade, you would be annotated as a Cat 'C' co-pilot. You kept your seniority but this caused other problems, when seniority determined the quality of the work you did, with the most senior crew members getting the most desirable trips, often with lucrative long sector premium payments.

**SITREP 6 – On the ground & in flight**

**WINTER OPERATIONS**

In this example, a Captain is faced with a series of difficult decisions during a Winter Operations situation. During this, he needed to juggle both the nature of the Icing conditions, the availability of a Departure ‘slot’, Crew Duty hours and the inescapable limitations of Crew Fatigue with dis-rhythmic side effects. This crew had been rostered for a duty called a Back-to-Back, in which two Trans Atlantic trips were strung together, with only minimum rest between the two. These were always followed by 5 days free from duty, so were popular ways of doing a lot of flying in a short period of time to acquire the number of credited hours to make the monthly quota. It was not uncommon for the flight engineer to be on a back-to-back, while the other crew members were not and this was the case on this flight. Thus the flight engineer was on his 4th Atlantic crossing in 5 days.

Washington DC, Dulles airport (IAD), is a very busy place at all times of the year. The combination of it being a major Operator Hub, major city transport feed and a Trans-Atlantic gateway, means that a wide variety of aircraft need to use it. The airport has adequate equipment and trained personnel to deal with winter conditions but during periods of high demand, there will sometimes be a wait, for the fluids required for the De-Icing rigs to heat up.

During the short bus ride to the airport, the flight crew were well aware of the prevailing conditions and that pre-flight de-icing would be needed. The weather was not particularly cold, but the snow showers were frequent and of short but dense duration. Timing would be of the essence, as the usual mix of de-icing/anti-icing fluid ‘hold-over time’ would be of the shortest time allowed – less than 10 minutes. At the aircraft, the de-icing rigs were literally standing by to start spraying the wings, thickly covered with fresh wet snow. The flight engineer did his usual external inspection and noted that no liquid was falling from the upper wing surfaces, meaning that the wing would be cold-soaked and that there would probably be ice beneath the snow. Rejoining his colleagues on the flight deck, he advised the Captain and Co-Pilot of what he had observed.

The passengers were loaded and the various external doors were closed, such that it was safe to call ATC and request Start Clearance. Being told to ‘Standby’ was not unexpected and this was later extended to ‘Expect further clearance in two-zero minutes’, again routine. Sitting on the warm flight deck, with a cup of tea and a substantial local style sandwich, the crew began to observe the adjacent aircraft’s wing, and the progress of their departure following de-icing treatment. This was expeditiously carried out and they began a slow push-back, during which time, our de-icing had commenced, using the hot 75/25 fluid / water mix prescribed. This process required that air conditioning must be switched off, to avoid fumes contaminating the air systems. The flight engineer went out to check that the process had completely cleared the horizontal surfaces and he was provided with a cherry-picker type vehicle to enable access to these.

By this time, the wind had increased and the snow had changed from wet fluffy flakes to tiny grains, as the temperature fell. Then, a window of clear weather appeared and the adjacent aircraft, now free from ice, completed the push back and commence taxiing. This was a disaster for the subject aircraft, as the wind direction and power required to move this departing aircraft, blew snow and slush, mixed with de-icing fluid run-off all over the freshly treated side of the still parked B747 left wing and tail. This was an unfortunate event as the de-icing rigs had departed to deal with another aircraft and had to be re-called. This took about 10 minutes, so the Captain made the correct decision to have the whole aircraft de-iced again as a precaution. The flight engineer prepared to go outside once again and ensure that all was well prior to departure; meanwhile the Co-pilot began to negotiate another departure slot.

During the second visual check on the cherry picker, the flight engineer observed that the safety gate on the cage at the top of the jib had a broken latch, such that if he leaned over the gate, it would open automatically. This meant that he could only look at the wings, rather than lean over and attempt to scrape off anything left on the wings. Clear Ice is notoriously difficult to detect on grey metal, but by the use of his powerful torch and professional knowledge of the aircraft profile, he satisfied himself that the wings were clean. He returned to the flight deck and divested himself of his cold weather clothing, a somewhat lengthy process. During this time, the Captain, alone with him on the flight deck, had a short conversation.

“The weather at LHR isn’t looking too special and Crew Scheduling are asking if we will go to Prestwick, for a ‘Re-Fuel and Go’ transit. Will you do that? The flight engineer thought about this for a few seconds and then made his decision.

“I’m very sorry Captain, but I can’t guarantee my state of fitness to fly two sectors tonight. If we go to PWK, we will not be the only ones doing that and I can see me having to do all the outside stuff, with possibly de-icing once again and in 6 1/2 hours time, I cannot reliably tell you how I will feel, now. Remember that this is the 2nd half of a back-to-back for me, Captain. It is best that you know this now, so that another engineer could be positioned up there if necessary”.

The Captain accepted the response and went out into the upper deck, where the co-pilot was talking to the stewardess in the small galley area at the rear. Seconds later he returned with the co-pilot and we made ourselves ready to commence our Start Checks. The Captain formally paused and said “Gentlemen. I have asked you individually to extend our duty tonight and you have both declined for your own reasons. If we have to land at Prestwick (PWK), we will get off and another crew will take over, or we will take minimum rest and carry on after that. I must say that I am disappointed, but I accept your candour and that this is the end of the matter”.

It really was the ‘end of the matter’ and the crew behaved professionally and cordially towards each other throughout the night. Short naps were snatched as required and the flight did in fact land at LHR directly. Following the flight, the Captain, a Senior Training Captain, went straight around to the Fleet management office and told the whole story to the Chief Pilot, with the final comment “Look XXXX, its winter on the North Atlantic and the workload is a pig. This sort of thing and a request like we were given needs looking into. Others, less experienced crews, might have accepted that call from Scheduling."

The Command lesson from this example is that there will be times when the individual crew members have to stand firm and work to their limitations. Company systems will often attempt to ask for 'more' or 'just this once' and there are other examples of where that took place. It will depend on the people, the places, the type of operation, the weather, a host of variables. The Commander had to juggle and prioritise these and keep reviewing them as part of their normal style.

**QUESTIONS**

1. What would you have done in this situation – if different WHY?
2. Why did the Captain ask the First Officer whether he was prepare to extend the Flying Duty Period (FDP) separately from the Flight Engineer?
3. Would you have done the same in similar circumstances?
4. If yes, Why? If not, why not?
5. How would you have handled the flight engineer had the First Officer agreed?
6. When would you take "matters" further, that is to the Management or even the Regulatory Authority had the FDP been extended?
7. Do you have to report such an extension to the FDP and justify it?
8. In what order would you approach the above?
9. Would you be taking "matters" further if the Captain had insisted you carried on after a Prestwick technical stop?

**WHAT CAN ONE LEARN FROM THIS?**

1. This Captain's command style was enlightened and considerate towards his crew's opinion as one would expect from a good training captain.
2. The Co-pilot and Flight Engineer not unreasonably questioned their ability to safely extend their duty period.
3. A thorough knowledge of operations in inclement weather procedures is of vital importance.

---

**SITREP 7 – In flight**

**RECOLLECTIONS OF A FIRST OFFICER**

Many years after the events, it is interesting to look back on some of the incidents that helped shape one as a First Officer, in preparation for the move to the left seat. An effective Captain is many things, but it is a mistake to think that there is a perfectly defined standard to which everyone may aspire. Different people have differing ways of dealing with other crewmembers, ground staff, airborne situations, etc., though, as we all know, the truly effective Captain will be a mixture of professionalism, humour, commonsense, technical knowledge and a myriad other factors. As a First Officer I flew with a wide variety of Captains; some were easy to get on with, others were not. As a Check and Training Captain I observed the same variety of personalities and skill sets in the person sitting in the left seat.

Time spent as a First Officer can best be looked upon as an apprenticeship, with the responsibility for progression divided between oneself, the Training Department, and, to a greater or lesser extent, the Captains with whom one flies. Though many Line Captains will disclaim any responsibility for training the spotty-faced youth (or lass) in the right seat, his or her performance both in the cockpit and on the ground will leave an impression upon their fellow crewmembers. Most of these impressions will, hopefully, be positive, though there are times when that is not the case. I had the opportunity to be part of two almost identical situations, within the space of a couple of months, with two different Captains. To say that they handled the situations differently would be an understatement.

The first situation arose with Captain A as Pilot Flying (PF). I was a fairly new First Officer in the company, and had never flown with Captain 'A' before. I had a lot of previous flying experience, gained first in the military and then with another airline, so I was comfortable in the role, and had received good reviews in my training. I looked upon my role as Pilot Not Flying (PNF) as being to support the PF and to relieve him of as much of the routine activity as possible. Captain A was a very senior Check and Training Captain with considerable experience on type.

We duly set off for our destination, a major Asian city about four hours flying time away. As we approached our destination – in perfect weather and early in the morning so that other traffic was not an issue – we went through the mental gymnastics of calculating the Top of Descent Point. As we compared our figures it was obvious to me that Captain A was out by about twenty miles, and on the 'uncomfortable' side. Despite my expressed concerns he stuck to his guns and we started the descent twenty miles later than I thought we should. Air Traffic Control cleared us unrestricted to an entry point about thirty miles out, which corresponded well with our company policy of using a thirty-mile 'gate' from which to refine the approach profile.

Despite my prompting in the descent and several statements to the effect that I thought we were way above profile and unable to make the 'gate' as per our company requirements, Captain A happily continued with his descent, occasionally commenting on the beautiful weather and scenery. At the 'gate' we were still way above profile, and when asked by ATC if we could, ".make it", Captain A advised me forcefully to inform them that we could.

Short of taking control, which I was not inclined to do, as we were not in imminent danger, all I could do was to make frequent and forceful verbal inputs. As I was new to the aircraft and he was a very experienced Captain on type, there was also the possibility that I was about to witness a brilliant transformation of the descent profile which would reduce me to an embarrassed lump of humanity and prove, conclusively, that First Officers should be ‘seen and not heard’!

Alas, that was not to be the case, and, as we floated towards the threshold at an altitude that would have tested the Space Shuttle’s vertical profile, I called, “Go around”. To his great credit, Captain ‘A’ responded immediately and we carried out a copy-book missed approach. ATC, it seemed, was not surprised and soon had us repositioned to land.

Apart from what I have stated above, what amazed me was Captain A’s reaction to the whole thing. Instead of admitting that maybe he had been wrong with his descent calculations, his lack of response to my inputs and failing to realize that a missed approach was required – in good time – he proceeded to rail against ATC, the time of day, the manufacturer of the aircraft, in fact, anything and anyone but himself. As for my inputs, they were not mentioned, and neither was the incident in the remaining days of our flying pattern together.

Quite by chance a similar incident occurred a short time later. Again, the Captain (Captain B) was very experienced on type, and a Check and Training Captain. This time, however, our flight was ending at home base, where the weather was relatively poor, with squally showers forecast. The approach briefing covered all the usual points, with particular emphasis on the weather that could be anticipated. Captain B was the PF and at a thousand feet disconnected the autopilot. What weather there was seemed to be of little consequence and the approach was stable, albeit slightly bumpy. Then, from out of nowhere, as we approached the threshold, we were hit by what seemed a wall of water and the aircraft moved sideways, well off the centreline of the runway. I immediately called, “Go around”, which Captain B carried out without hesitation.

Throughout the missed approach procedure I contemplated my decision to intervene and wondered what Captain B would have to say once we were back on the ground. I need not have worried. Captain B thanked me for my intervention and remarked that he had been so focused on flying the approach that the significance of the squall-induced windshear was not immediately apparent to him.

As a First Officer I never again had to call for a Captain to go around. However, I often reflected on these incidents and what I had learnt from them.

**QUESTIONS**

1. If Go-around was called and you were the handling pilot would you carry it out immediately?
2. Do you consider all your options prior to making an approach? Fuel – endurance, can I do another circuit and have I sufficient fuel to divert after the second approach?
3. If you unfortunately misjudged a descent and could recover with speed brake and / or gear, what would you say to the non-handling pilot?
4. Admitting a mistake, is good or a bad thing?
5. Do you think that your NHP will give you more support as a result? If yes why?

**WHAT CAN ONE LEARN FROM THIS?**

1. Captain A was known to be ‘Old School’, intolerant of criticism of any sort, and a bit of a ‘one man band’ in the cockpit. Captain B, on the other hand, though only slightly younger, had a reputation as a good trainer with a comfortable yet firm cockpit manner.
2. Clearly the role of the Captain is to establish the atmosphere in the cockpit, through that mixture of professionalism, humour and technical knowledge previously referred to. In addition, he / she must be prepared to accept information from all sources, even from an inexperienced First Officer. While there should never be a situation that dilutes the authority of the Captain, an effective Captain will see him / herself as the team leader, absorbing information from all quarters, internal and external, before making decisions. It is often a difficult juggling act, but one that brings tremendous professional satisfaction, not only to the Captain but also to those crewmembers who work alongside.

---

**SITREP 8 – In flight**

**SMOKE IN A HELICOPTER COCKPIT**

I was flying a Whirlwind 10 single engine helicopter over the open grass of RAF Leconfield making a long, gentle approach to the SAR dispersal on the far side of the airfield. It’s fair to say that the last thing on my mind was a sudden, unexpected emergency. At an altitude of about 400 feet and a speed of 50 to 60 knots there was a loud, rushing bang and the helicopter’s cockpit filled with thick, acrid smoke.

Training takes over in such circumstances and I instinctively lowered the collective lever to maintain rotor rpm by auto-rotating down. Probably a little part of my brain had worked out that a sudden bang plus heavy smoke when you’re virtually sitting on the engine is bad news as far as power goes. I couldn’t even check whether the fire extinguisher light was illuminated as there was almost zero cockpit visibility until I managed to jettison the side window, which cleared the view a little. The resultant fast, auto-rotative landing resulted in nothing worse than a bent tailskid.

Inspection of the engine bay showed considerable scorching. A transmission gearbox had seized and the engine’s automatic control had tried to turn the now stationary power turbine with the consequent spectacular results.

Hopefully few pilots will experience the speed with which smoke in the cockpit can deprive you of every source of information by which you control the aeroplane. What would you do if smoke filled your cockpit at 400 feet on finals?

**More on smoke in a cockpit**

The technical manager and two first officers from BA's Trident fleet were tasked with flying a Trident from Basle back to London on a two engine ferry. The 'Gripper' was underpowered at the best of times so each two engine ferry was precisely planned taking into account the actual conditions at the departure airfield and a carefully calculated aircraft weight rather than using generalised performance data.

I was operating the flight engineer's panel behind the two pilots. All went well until about 5000 when we started to pressurise the cabin. A pungent smell pervaded the cockpit followed by blue fumes, then smoke. The captain ordered smoke drills and we donned our masks and re-established communications. The first officer was told to fly to a safe altitude while the captain and I checked the engineer's panel for clues; nothing abnormal could be seen. Manually opening the cabin air dump valve quickly started to clear the cockpit and after a minute we could safely remove our masks.

I can't remember whether we continued unpressurised or with partially restored pressurisation. What I can remember are the calm, clear instructions to both F/Os from the captain, the complete lack of any rushed actions and the careful review the available information before taking action. It was a classic example of good CRM in the days before we even knew what CRM meant.

**QUESTIONS**

1. Would you have handed over to the NHP?
2. Could you have been as calm as this captain?
3. What are the disadvantages as captain of rushing?
4. Was it a good idea to tell the NHP to climb to a safe altitude?
5. Who was "Minding the Shop?"

**WHAT CAN ONE LEARN FROM THIS?**

1. Fire or smoke inside the fuselage of an aircraft is the most terrifying thing for a pilot.
2. The smoke spreads so fast, it is not only blinding but it is suffocating.
3. You cannot get on the ground quick enough, so do not delay.
4. Get on oxygen and get on the ground.

**COMMENTS**

1. A delayed landing, particularly after a fire on board, whether in the cabin or out of sight behind lining panels, under-floor or outside the pressurised fuselage area, may have fatal consequences as countless accidents have shown in the past. On 2 September 1999, Swissair MD11 Flight SWR 111 crashed into the Atlantic Ocean southwest of Halifax International Airport at the entrance to St. Margaret's Bay, Nova Scotia. The crash site was 8 km from shore, roughly equidistant between the tiny fishing and tourist communities of Peggy's Cove and Bayswater. All 229 people on board were killed. This was after a major in-flight fire that investigators believed had started in the flight deck roof area. The fire took hold and destroyed the aircraft before the crew could land it, after a delayed decision to descend for a landing.
2. Pan-Am Flight 160, (a Boeing 707-321c) on its way to Prestwick from New York, crashed on 3 November 1973, short of runway 33 at Logan International airport, Boston, when the crew was overwhelmed by smoke on final approach after noxious smoke was generated from improperly packed cargo. These are only but two examples of countless such fire/smoke induced accidents over the years.

**ADDITIONAL CONSIDERATIONS**

The Flight Operations Group views on how fires in the air should be dealt with and on checklist contents presentation to help crews in such an emergency are contained in Appendix 4 of the RAeS Specialist Document ***Smoke, Fire and Fumes in Transport Aircraft***, published by the Society in January 2007. Extracts therefrom are reproduced hereunder for the attention of readers and **serious consideration by Regulators, Manufacturers and Operators.**

**SMOKE, FIRE AND FUMES CHECKLISTS – Vital Primary Considerations**

***In the opinion of the Flight Operations Group, the opening sequence of the Smoke, Fire & Fumes drill for flight deck crew should be the MEMORY ITEMS shown hereunder. Readers are reminded that until varied by the airline with Regulatory agreement, the Company SOP and 'Abnormal operations/Emergency drills' must be adhered to, as a first course of action.***

| CALL | **RESPONSE** (With comment to explain) |
|---|---|
| 1. OXYGEN MASKS (full face)<br>*Then, (but should not be an option…)*<br>🡇 | **ALL CREW - ON, 100 %, MIKE TO MASK**<br>(Confirm oxygen switch is set to 100% & mask-microphone is selected) |
| 2. SMOKE GOGGLES<br>(if not full face mask) | **ALL CREW – ON** (Don & fit to face) |
| 3. CREW & CABIN COMMUNICATIONS | **ALL CREW – ESTABLISH**<br>(Notify Cabin Crew using mask-mike inter-comm) |
| 4. FLY THE AIRCRAFT | **CAPTAIN - DECLARE**<br>(Decides who by and how – manually or autopilot). |
| 5. ATC COMMUNICATIONS | **CAPTAIN - DECLARE EMERGENCY > MAYDAY CALL**<br>(On route frequency or 121.5 & SSR code 7700 if required) |
| 6. DIVERSION FOR LANDING | **CAPTAIN - CONSIDER / INITIATE & REVIEW LATER**<br>(Review / cancel if situation under control) |
| NON - HANDLING PILOT NOW COMMENCES SMOKE, FIRE & FUMES DRILL | |

**Note 1.** Regarding Step 1 and Oxygen checks, it is VITAL to ensure during pre-flight checks, that the oxygen system is turned fully ON and that individual mask checks test the flow for a significant period and not just perfunctorily for a very brief second, to confirm the system is fully pressurised.

**Note 1a.** Step 1 (and 2 if not a full face mask) : Oxygen masks (and Goggles where necessary) must be donned at the first indication of air contamination, not as the FSF table suggests " ... if Required". The idea is to stay alive and not become incapacitated. It is strongly felt by the FOG that by waiting to assess the situation subjectively, it may be too late to protect oneself if rapidly disabled, particularly by noxious fumes. Due to the complex cocktail of fumes and smoke generated at the onset of some fires in the air, a crew can be easily overcome before realizing or discovering the onset of impairment.

**Note 1b:** Whether the 100% oxygen flow selector is wire-locked to that switch position or not and notwithstanding that it might have been so set during pre-flight checks, this vital toggle position selection MUST be confirmed after donning the oxygen mask, when the mask microphone is also switched ON. *'Flow Indication Irises'* such as those fitted on 'EROS' mask sets, must be checked to confirm flow both pre-flight for at least 10 seconds and at the time of donning for use in anger.

**Note1c:** The FOG, and many within the industry, support the use of full face masks and encourage all Operators to install and Regulators to require, full face masks and stop the use of the two stage so-called protection where separate goggles are donned after the oxygen mask, so wasting precious time with eyes unprotected. Furthermore, goggles do not assure eye protection whereas a full-face mask does.

**Note 2: S**tep 4 requires that a pilot is nominated to fly the aircraft whilst the rest of the crew deals with the emergency. It appears as step 4 in this checklist because other higher priority 'survival' aspects need addressing first. In other checklists, this step should be the first item in every emergency drill as a vital standard SOP requirement, where donning an oxygen mask first is not required to stay alive.

**Note 3:** At Step 5, the Captain advises ATC on the frequency being used at the time of the occurrence, that an abnormal fire smoke or fumes situation exists and declares an emergency by way of a MAYDAY call. Surprisingly, a Pan call may not be understood by controllers outside the UK and the USA or even in certain parts of Europe, hence the need for a MAYDAY call.

**Note 3a:** When outside VHF coverage, it is recommended that a MAYDAY call be made on 121.5 even if a MAYDAY call has been made and acknowledged on HF. Although far from normal VHF coverage, relays through other aircraft that maintain a listening watch on VHF frequency 121.5 as per International Regulations and normal practise, may overcome HF bands communication problems on what could otherwise be congested ATC non-VHF route frequencies. Even if a MAYDAY call is made on HF and acknowledged, a repeat of the call on 121.5 is worth giving as it may be picked-up by a satellite and relayed to a ground station that could assist in some way, thus maximising all available help.

**Note 3b:** SSR Squawk Code 7700. To indicate an emergency condition, this code should be selected as soon as is practicable after declaring an emergency situation and having due regard for the over-riding importance of controlling the aircraft and containing the emergency. However, any SSR code setting previously assigned by ATC (other than the conspicuity code 7000) should be retained unless, in special circumstances, the pilot has decided or has been advised otherwise. Obviously, in mid-Atlantic an aircraft would not normally have an allocated SSR code and therefore squawking 7700 is required and will be prompted by the checklist.

**Note 4:** That *"a diversion for an immediate landing may be required"* is an important step. So as not to take such a rigid position that the industry does not 'hear', an early choice is provided in the checklist by stating, "CONSIDER (diversion for an immediate landing)". In that way if the source of the smoke is a windshield heat control box for example, the Captain can assess and apply the appropriate procedures. Then, if the known source is unequivocally confirmed as extinguished, there may be no need to request diversion for an en-route landing. However, a precautionary landing to assess the extent of any hidden collateral damage is worth considering.

**Note 4a:** The need for an early landing is based on the fact that the all-fly-by-wire aircraft systems are interconnected in such a complex way, that a rapid preliminary assessment may do little good. It is better to assess the situation on the ground. We must also remember that most of the aircraft structures are not accessible and have no thermal sensing or fire suppression capability. So getting on the ground may have to be a primary consideration on such aircraft.

**Note 5:** The question "Is a 'landing' airport distant ?" should be asked at some suitable point in the drill. It is a consideration of importance. If YES, then there may be time for trouble-shooting. For example, after all main electrical power is switched-off as a part of the drill, the rebuilding process begins. If time is short, then the aircraft may need to be landed on essential power only. Drills should be constructed accordingly.

**AIRLINE MANAGEMENT**

Management guidance and regulatory compliance documentation (Flying Crew General Orders) should include a version of this statement: Emergencies involving smoke or fire from unknown sources during flight require a commitment to land as soon as possible. If the source of the smoke is known, such as from a lavatory waste paper bin or a seat upholstery fire, the Captain can assess the situation once the cabin crew has applied the appropriate procedure. There may be no need to divert for an en-route landing if the known source is confirmed unequivocally as extinguished and kept under close surveillance for the remainder of the flight in case the fire flares up again.

---

## SITREP 9 – In the air

### CFIT AVOIDED

I had recently converted as an F/O onto the Viscount and was flying a night trip to Edinburgh with a pleasant and very experienced captain.

All went well and we were letting down to Edinburgh from the south cleared to 3000 feet. The visibility was excellent and we could make out the lights of the town and the airfield from thirty miles away. The captain reported 'field insight', our IFR flight plan was cancelled and we were cleared for visual approach to runway 13. The captain called for the landing checks and started a descent but made no effort to turn left to position for an approach on 13.

I suddenly realised he was lining up on the short runway used by the local UAS who were engaged in night flying training. Worse we were approaching the Pentland Hills well below safety height. My warning produced a rapid climb to safe altitude and we landed safely some ten minutes later. The captain was profuse in his apologies and thanked me for my prompt warning.

**QUESTIONS**

1. What would you have done as captain?
2. Is there a need when doing a visual approach to have checked the aerodrome plate to see where the terminal is (Brightest area of light)?
3. Which side of the terminal is the runway?
4. Does the runway have PAPIs or VASIs?
5. Do you need to be aware of your MSA on a visual approach?
6. Do you need to have briefed for a full IFR letdown at Top of Descent when the weather is CAVOK?

**WHAT CAN ONE LEARN FROM THIS?**

1. Use every aid available TO YOU, to establish you are pointing at the intended landing airfield and runway, be it a VOR, ILS or NDB, without forgetting eyeball Mark 1, to compare the scene mentally with the airfield chart previously consulted at the before descent approach briefing stage of the flight.

---

**SITREP 10 – In the air**

**MORE HASTE, LESS SPEED**

Flying as captain of a 757 approaching Heathrow from the north we were offered a 'Westcott snatch', a shortened approach slotting us into the stream of early morning long haul arrivals landing on the easterly runway. The F/O was flying and made a good job of the rapid descent and programming the autopilot for our ILS approach.

Unfortunately the autopilot failed to capture the localiser and with ATC's permission we turned back to intercept from the other side while continuing our descent through about 2000 feet.

I remarked to my F/O that if we did not capture the localiser by 1500 feet we would have to go around. The next thing I knew we were pointing skywards with full power applied then, while still in a nose high attitude, I noticed the throttles retarding. I took control, disconnected the autopilot and auto throttles and levelled at 3000, mentally still a thousand feet and ten seconds behind the aircraft.

After landing a mandatory report was required but neither of us could explain clearly what had gone wrong. Two hours and several coffees later, after much delving into technical manuals, we had our answers.

1. Both of us had been mentally preparing for a go around.
2. The F/O only heard the 'go around' part of my remark about what we would do if we failed to capture the localiser.
3. He pressed the go-around switch which commanded full power and a climb. Once the rate of climb passed 2000 feet per minute (fpm), attained almost immediately, the auto-throttle correctly retarded power to maintain 2000 fpm.
4. The F/O did not call 'going around' as he pressed the go around switch.
5. For me as the non-handling pilot the sudden, unexpected event was alarmingly disorientating for several seconds.

**QUESTIONS**

1. Was it a good idea for the crew to have had a post-mortem?
2. Should they have just ended the day with "Oh well" and gone home?
3. What is you company rule about talking on the flight deck below 10,000 ft?

**WHAT CAN ONE LEARN FROM THIS?**

1. Captains need to keep in mind that it is their responsibility in high workload situations to give clear, concise commands and not to engage in unnecessary talk, however well intentioned. Under stress people hear what they want to hear!

---

**SITREP 11 – On the ground**

**DEFERRED DEFECTS (DD) & MINIMUM EQUIPMENT LISTS (MEL)**

The service was a flight from LHR routing overhead Zurich to Venice departing after sunset. The weather en-route was good although significant cloud was forecast in the area of the Alps. The aircraft offered (a B757) had the right pack switched-off due to a faulty indication. The pack was very probably serviceable in that it would very probably have satisfactorily supplied conditioning air had it been switched on.

Examination of the tech log showed that the left pack had failed in flight four times in the previous fortnight. On each occasion maintenance had worked on the system, ground tested it and declared it serviceable.

I declined the aircraft because in my view, the probability of further failure of the left pack was unacceptably high and without a serviceable right pack such a failure would inevitably result in an emergency descent, possibly into a region with a high MSA.

An engineering manager was called who first tried to persuade me that because the left pack was signed-off as serviceable, the aircraft state was therefore within the requirements of the MEL. I agreed that this was the case but that my decision was not based on the MEL but on my judgement of the risk of a further failure. He then suggested that even if there was a failure of the left pack, the right pack could be switched on and would maintain pressurisation in spite of the defect recorded in the tech log and the consequent maintenance action.

I said that if the tech log defect was signed off and the right pack declared serviceable then I would accept the aircraft. 'Maintenance' was not prepared to do this, so I rejected the aircraft and the flight operated with a replacement one.

My action was reported to my Flight Manager who supported my decision.

**QUESTIONS**

1. Would you have handled the situation any differently ? If so how and why ?
2. What does the law say about the captain's responsibility in accepting an aircraft for service?

**WHAT CAN ONE LEARN FROM THIS?**

1. The Captain's responsibility goes beyond the MEL. The MEL cannot take into account every set of circumstances, but the Captain has a duty to do so as far as is possible. Captains must be aware that the acceptance of such MEL and/or Deferred Defects Manual (DDM) is their responsibility, not maintenance or dispatch. Remember the law; it is a captain's responsibility to decide if an aircraft is fit to commence a flight.
2. An engineer may suggest that a system is in fact usable even though it is unserviceable according to the tech log. It is unsafe to rely on such a suggestion. If the system can be used then it can be signed off.
3. An engineer's signature proves only that any required work has been completed and the engineer believes that the aircraft is fit for service in accordance with maintenance requirements. There are circumstances, as in this case, where the history of the aircraft and the circumstances of the planned flight may suggest that a more demanding standard is appropriate. Remember that in the final analysis it is the commander's opinion which matters. It may be that discussion serves to change the commander's opinion and therefore his decision, but the fact that there are other opinions cannot override the commander's opinion. If that opinion is that a certain course of action is necessary to secure the safety of the operation then the commander must follow that course of action in spite of contrary opinions.
4. **Also see Part 2, Section 3 at 3.4**

---

**SITREP 12 - In the air**

**VIGILANCE AT ALL TIMES**

As co-pilot, I was flying the descent and approach at night to Madrid from the North to land on Runway 33. It is worth noting that at this time R33 had a steep upslope at the threshold, edge lighting only and a hump that made the far end lights invisible in the flare.

As we flew downwind it became apparent that we had a headwind of about 50 knots. We discussed the fact that this suggested that there might be a strong tailwind on finals. The surface wind on the ATIS was 190/3 knots. A number of requests for the surface wind were made during the approach, each of which received the reply "190/3 knots". The approach was conducted with care, with the landing configuration established in good time to ensure that the strong tailwind that was present did not make it difficult to achieve the correct approach speed. Once the final approach IAS was achieved, we watched the tailwind on the FMS. This came within limits at about 800 feet and continued to decrease to a tailwind of about 8 knots, well within limits, although somewhat above that to be expected from the surface wind of 190/3 knots and which was still being passed by ATC.

The Captain took control for the landing at 1000 feet as per the SOP. The landing was very smooth and seemed quite normal until the Captain said: "Look at the attitude"; at which point I saw that the pitch was decreasing through about 8 degrees.

As we taxied in I called the cabin crew at the rear and asked if they had noticed anything unusual during the landing, but they said they hadn't. Once on stand I inspected the rear fuselage which had a long streak of bright metal, clearly the result of contact with the runway during the landing. A subsequent discussion with the cabin crew revealed that they had heard a scraping sound but did not think it was something we would be interested in.
We never discovered whether the differing wind reports were a product of the unusual terrain around the 33 threshold or some defect with the anemometer or some other factor. The subsequent investigation revealed that we had encountered a tailwind gust of about 18 knots just before the flare, which probably made the Captain sense a sink and, in combination with poor visual cues, caused the over-rotation.
With hindsight I believe that having identified and successfully overcome a potentially serious problem, after the wind came within limits at about 800 feet, I relaxed too much. It is impossible to say whether I could have intervened successfully but in the event I reacted as if my job was over before the flare was reached. Although I was co-pilot in this event, the lesson is relevant to Captains. As they say *"The job isn't over until the paperwork is done."*

**QUESTIONS**

1. Would a post incident crew discussion have been a good idea?
2. When ATC are asked for a surface wind, do they give the most recent ATIS wind or the actual surface wind?
3. Do you think that there was a mind set to land?
4. What would you do in the event of a sudden and abnormal pitch change on short finals?

**WHAT CAN ONE LEARN FROM THIS?**

1. When a problem is encountered and successfully overcome, there may be a reaction which lowers what the experts call 'arousal' below normal and desirable levels. The more significant the problem, the greater this tendency may be, but often the flight will not be complete at this point.

---

**SITREP 13 – In the air & later on the ground**

**NOXIOUS FUMES**

I had a flight with a sub-chartered operator on behalf of a major European airline from Birmingham to Frankfurt.

Take off was normal but after about 30 minutes the cabin staff announced that we were returning to Birmingham - no explanation was given. The captain spoke on the PA system 10 minutes before landing just to say that we were going to land in 10 minutes.

After landing, we exited the runway at the first available exit then immediately stopped and shut down. We were met by a full emergency call out and were evacuated from the aircraft. We were then advised that the flight deck crew had been severely affected by noxious fumes - thought to be from a partial engine failure.

**Some interesting facets**:

Fumes from the air conditioning system engine-tapped hot air, is not an uncommon event on BAe146 aircraft.

Neither pilot donned any apparatus or had taken advantage of crew Oxygen, although it was obvious that both were affected. The pilots were attended by paramedics after landing.

On evacuation from the aircraft, we were boarded to a standard passenger transfer bus parked about 30 meters from the aircraft but then stayed there for about 20 minutes.

Strangely, I was on my way to a meeting at Lufthansa Flight Training. As there was no possibility of a seat to Frankfurt that day, I took a Dusseldorf flight and continued by train - making the meeting start at 09.00 the following morning. This gave me the perfect opportunity to talk about this incident and the way it was handled, from a passenger's point of view.

Discussing the events of the previous day at Lufthansa Flight Training (LFT) the first thing that was apparent was that, although the operator is a subsidiary of a major EC airline, the training between the airlines differs considerably. Since the passenger buys a ticket issued by the major operator, I felt that it has some responsibility for ensuring equal standards!

As a result, I agreed to forward copies of the Flight Operations Group Specialist Document, Smoke and Fire in the Air (SAFITA) direct to the operator of the HS 146 (and the two flight-deck crew). Because of its importance, that Specialist Document is recommended reading.

**QUESTIONS**

1. What would have been your first reaction to fumes on the flight deck?
2. When and how would you have handled the brief to the senior cabin crew member?
3. What would have been your instructions to the senior cabin crew member?
4. What would have been your order of priority in this situation?
5. Would you have landed back at Birmingham, if not why not?
6. Would you have ensured that there was a briefing to the passengers for an evacuation?
7. Would you have delegated this briefing to the senior cabin crew member, if not why not?
8. How in your opinion were these passengers cared for?
9. What would you have ensured was done for them?
10. Would you have been in a fitter state to care for the passengers and why?
11. What would have been your number one priority in this situation at the onset of fumes?
12. What would have been your number two priority?

**WHAT CAN ONE LEARN FROM THIS?**

1. It would appear that this first-hand account of an in-flight smoke/fire/fume event adds further proof of the need for training and improvements. The failure of the crew to use the protective equipment (oxygen masks and goggles) is a training failure. The failure of the crew to inform the passengers of the event is also a training failure, whereas the complexity of the checklist they were using is an organizational failure.

2. That the flight returned to Birmingham after 30 minutes in the air, which would have brought it into the Southern UK airspace, if not mid-Channel, instead of landing at a closer airport such as Stansted, or Manston or Ostend, exposed the aircraft to unnecessary dangers.

**SITREP 14 – In the air**

**SMOKE!**

It happened on 12 April 1966, the details still seem indelibly stamped on my memory, but it is hard to be sure how much of what I remember is as it really was, or how much is what I have rationalised afterwards. What I do know is that it altered my whole attitude to aviation, as I will explain.

During my 36 years of flying I only had two searing experiences; one was the smoke incident in the right hand seat of a Super VC-10, G-ASGC, which is now preserved at the Duxford museum. The other, at the opposite end of the spectrum, was at my fleet manager's desk in 'TBA' (BA Technical Block A at LHR) dealing with the aftermath of a B747 incident.

Although I have recounted the smoke incident to a few people at various times, I have never revealed all the surrounding details and I have never written about it, so what I will now tell you is the whole story as I best remember it, some details of which are personal, and some of more general interest.

We were rostered for the standard trip LHR-JFK (night off), JFK-PWK-MAN (2 nights off), MAN-PWK-JFK (night off), JFK-LHR. The crew consisted of the captain who was wartime ex-RAF (bombers I think), the senior first officer, also ex-RAF, he had done national service followed I think by a short service commission (I know he had been on Hunters at one time), the senior engineer officer (whose background I can't remember) and myself - the junior first officer (ex-Hamble with all of three and a half years in BOAC), and six cabin crew. As was usual in those days, I navigated the outbound Atlantic sector and was due to sit in the right hand seat on the return leg.

On our first night in New York, and this is eerie, I was discussing flying experiences with the SFO in a bar and saying that I was still wet behind the years and nothing much had ever happened to me. He described an incident he had had in a Hunter when flying at very low level (I think off the Dutch coast) when he suffered a bird strike which had broken through his windscreen, knocking him out. He came to, to find the aircraft climbing and, surprisingly, everything under control despite being cut around the face and head. Evidently the normal procedure, when low flying, was to trim the aircraft very slightly nose up so that in the event of an incident or some slight inattention, the aircraft would fly itself in the right direction away from the ground – and he was very thankful that he had done that. I can clearly remember saying at some stage during the conversation that I had never had any kind of emergency or anything frightening happen to me in an aircraft and that one part of me hoped it would happen one day, just so that I would know how I would react and whether I could cope. As events turned out….well, talk about tempting fate! I am not superstitious but I never said such foolish things ever again.

Next evening we made a normal max weight take-off from 31L, turning out over Jamaica Bay and climbing to altitude along the southern shore of Long Island, to head off towards Newfoundland and the Atlantic. As I remember it, the night was reasonably clear, dry and without any significant weather problems. At some stage during the climb we started to smell a hot burning smell that seemed slightly electrical, but none of us could really put our finger on it. The SFO went back to see if the stewardess had burnt the first class hot towels, a not unusual occurrence as they used to be warmed up in the galley oven and sometimes forgotten – but that was not the cause. The smell became slightly stronger and I think the engineer went back to see if there was anything wrong in the galley because it really did smell electrical and we also looked around the cockpit – but there was nothing. I can clearly remember switching off the aileron upset at 24,000 feet, so I know that we were just above that altitude when it happened. Suddenly, from all around, from under the instrument panel, from above my head, from behind my seat thick smoke poured out completely blocking all visibility. I think someone shouted: "Get on oxygen" but I really can't remember, nor can I remember even putting my oxygen mask on, but I think I must have because I remember fiddling around with the plastic flap down by my right leg where the mask was kept, but I may have given up because I couldn't find it – I really don't know. The next thing was the autopilot coming out; I remember the aural warning and the captain shouting that we were on fire and must make an emergency descent and depressurise. Whether he disengaged the autopilot or it fell out I will never know. At this stage visibility in the cockpit was down to about six inches.

Then the engineer shouted that he thought it would be a good idea to kill the radio switches, and I can clearly remember thinking what a good idea, and I think the captain said yes, do it. BIG MISTAKE … We were all ex-'Britannias', and on the Britannia 312, the radios were in the back of the flight deck and the smoke drill involved switching off the radio switches. I cannot remember what else (if anything) was switched off by this action on the Britannia, but on the VC-10 the radios were in the radio bay below the floor, where they couldn't make smoke in the cockpit AND in addition to switching off the radios, these switches also switched off the main flight instruments (Horizon, Compass, Altimeter).

Everything was happening very fast, I have no idea of the timescales, but the next thing I was aware of was the captain shouting that he could not see his flight instruments and the high speed warning horn sounding off. Whether the sequence was in the order I have described or whether the captain shouted that he could not see his instruments before the radio switches were switched off, or whether it was all at the same time I do not know. What I do know is that I put my chin on the top of the control column and pressed my forehead hard against the coaming and could just see the horizon and the other instruments but only one at a time as I moved my head around. I can clearly remember seeing the warning flags on the horizon, on the compass and on the altimeter but I did not associate these with having switched off the radio master switches. What did chill me was that the altimeter was stuck at 18,000ft., and the VSI pointer was on the stops pointing down at over 6000ft/min. I remember thinking there is going to be a bloody great bang in a moment and then thinking you can't just sit there – you have got to do something. I shouted that I could see my instruments and started to try to fly the aircraft too. And that was when good Hamble training kicked in.

At Hamble we had all done lots of recoveries from unusual attitudes, on instruments, on limited panel, in Chipmunks. By this time I could see the airspeed needle somewhere on the right hand side of the ASI, I could see the VSI needle on the stops, and I could see the turn and slip (I think it must have been showing a hard left turn because in my memory all I can remember is turning the control wheel to the right) and realising that we were in a spiral dive. I shouted: “I have it, I can see my instruments” but I doubt very much that the captain relinquished control, so I suppose we both flew it out. I knew I first had to get the turn needle into the centre, and only then pull back until the VSI started to come back to a normal reading, and to very carefully check the airspeed so as not to overdo it. I don’t remember the high speed warning horn stopping, but it must have. Gradually the smoke began to clear and I became aware of the SFO lying across the centre console and that we were climbing gently (he said later that he had had his head up against the standby horizon so that he could call out the attitude, but I was totally unaware of that). He also told me that the G forces had pinned him there but, again, I don’t remember any G forces.

At some stage the engineer must have switched on the radio master switches and I became aware of ATC calling us. I can’t remember what they were saying, but my first words on the R/T were; “We’re on fire and we can’t see a bloody thing”. As things gradually returned to normal I realised we were climbing (I think through somewhere around 20,000ft) and were heading west, in the opposite direction. How low we went or how fast we went, I have no idea. Neither could we find out later; it was before the days of flight recorders.

The captain asked for an immediate return and that we would land overweight without dumping fuel because we were still convinced we had a fire somewhere on board. ATC were excellent, they had cleared all the other traffic off the frequency, they asked about the nature of the problem, and I can remember saying something about smoke and that we thought we were on fire, and they gave us vectors to 31L that were exactly right – neither too rushed nor too long, I felt so grateful to that controller. The approach and landing was normal, but at a suitably faster speed. The aircraft stopped with lots of runway length to spare, I can remember being surprised at how much runway was left in front of us. We were then surrounded by fire engines and I think the captain must have talked to them about signs of fire, I cannot remember any details other than it was decided to taxi in without evacuating the passengers.

When on stand, the local manager and ground engineer piled onto the flight deck and there were a lot of other people around, but I do not remember much as I think I was just doing a normal shut down checklist probably taking refuge in a normal activity. The passengers were offloaded, one was a priest who made a sign of the cross and blessed us; another man was on his first flight and said he would never fly again – I don’t blame him.

Then I think we just sat there while the captain and manager decided what to do next. I do remember someone giving us a bottle of whisky saying we might need it, and we all got off and went back to the hotel doing all the usual things one does after a flight but in a kind of blur. That night I think we sunk several bottles in the hotel!

Next morning I went for a walk in Central Park and have never seen the world looking so beautiful before or since.

As I write this, I cannot check my logbooks because they are still in a packing case somewhere; we have recently moved house. But we then operated the normal schedule to Manchester, I think the very next day. In Manchester the captain went down to London to explain the incident and we continued the rest of the trip itinerary, but with a new captain. I think we all behaved and flew normally, and it wasn’t until I got home that I let go. I don’t think I was given any time off and neither did I ask for it. Of course, the rumours started flying round the fleet and at slips I heard people talking about it, not knowing that I had been one of the crew, and they had some hard things to say about what we had done. It hurt, because I knew that we had made some dreadful mistakes, but I didn’t let on.

So what were the lessons? On the plus side, I had discovered that I could act rationally when in extremis, and that I found comforting. On the minus side, I knew that we had done lots of things wrong and I found that very humiliating; it took quite a time to regain my confidence, not because I had been frightened (which I had been) but because I knew that I did not know enough about flying in general and my aircraft in particular. And I vowed never to be found wanting again, perhaps I even became a little obsessive. I read avidly, I read manuals, I asked questions of instructors, I tried to find out as much as I could about flying and I wanted to know the derivation of everything; and it was that which probably led me to become first a navigation instructor and then a simulator instructor, eventually leading to a whole career in training and management.

Regarding the incident itself, the engineering investigation found that an oil seal in the Godfrey blower (an engine driven compressor providing air to the cabin pressurisation system – the VC-10 did not use engine bleed air) had failed so that all the gearbox oil had leaked into the compressor itself, had been vaporised, and pumped straight into the cabin. Fortunately, it was non-toxic and non-irritating; otherwise I don’t think we would have regained control. The flight operations investigation (which involved only the captain and engineer) found that we had done a good job and we were all presented with a commendation by the chairman, Sir Giles Guthrie. BUT I knew in my heart that we had not deserved it, we had made too many mistakes, and it was that that upset me and drove me on. We had rushed into action too fast, we had not left the autopilot engaged for long enough, and we had reverted to previous type and switched off the radio master switches without realising the consequences.

The main flying lesson for me was: - don’t rush into action, stop, think, analyse and only then do something. With hindsight it is easy to see that had we just sat on our hands and done nothing at all, the oil would all have been vaporised, blown through the cabin, and the smoke would eventually have cleared by itself. Obviously, in the situation we had just experienced we had to act fast. But in most emergencies there is usually time, maybe only a few seconds or minutes, to pause and analyse before leaping into action. The next lesson was to know much more about the aircraft and its systems. I should have known not to switch-off the radio master switches, because they not only disabled the main flight instruments but also the autopilot. That action, more than anything else, turned a minor incident into a near accident.

**COMMENT**

The more I continued to fly the more I never wanted again to be in the position where I could be suddenly caught out. As a navigation instructor, I used to ask my pupils how they would tackle certain situations that I would dream up for them. I tried to be careful to explain that I was not trying to catch them out, but merely to extend their knowledge, and mine. I would join them in the manuals to work through some bizarre problem that I had dreamt up. I used to do the same on the simulator when I became a simulator instructor and had some spare time. Sometimes I did it with a pupil and sometimes I did it on my own. In retrospect I just hope that my pupils did not see my obsessive 'what ifs' as threatening but instead, a real desire to seek the truth. When I became a captain I would pass the time in the cruise thinking up problems for myself, deciding how I would tackle them and then check to see if I was correct by going through the manuals. I often wonder now what my crews must have thought.

As I got to know myself better I found that I was not so good at some handling items, for example throughout my career I always sweated on three engine ILS and NDB approaches, when others could fly them like a dream. But I compensated by knowing my way around the manuals and developing what I think was a thorough understanding of what was necessary for making good tactical decisions. But of course that still did not prevent me from making mistakes.

I also became very interested in why people made mistakes and what were the real causes of accidents. So much was just put down to pilot error, which at the superficial level is true, but the really interesting bit is to try to find out why human beings make mistakes. Remember, this was still at the time when training departments viewed mistakes as heinous crimes and not as learning opportunities. I read up on the psychology of visual perception and found out how easy it is for the human animal to misperceive and be misled by visual illusions. I read up on stress and fear to find out more about why and how humans react the way they do and found out how human perception narrows down as stress and workload builds up. I read the various books on human error and how we are all prone to false hypotheses – <u>and that was the really interesting one</u>. If something happens and you accept a false hypothesis, and you are under stress, it is very probable that you will continue to act upon that hypothesis and not be able to change it. You will then carry out a set of actions which may well be the right ones for the hypothesis but not appropriate for the actual situation.

**QUESTIONS**

1. Would it have been a good idea for the captain to have called the flight deck crew together after the incident and discussed the whole episode?
2. Was it a good idea for the crew to continue to operate the schedule?
3. Could stress have developed to the extent that it might have impaired the safety of the subsequent sectors?
4. What would you do to reduce stress in a crew member?
5. What do you know about stress?
6. Where could you learn more about stress and its symptoms?

**WHAT CAN ONE LEARN FROM THIS?**

As a result, I came to accept a set of rules which I tried to inject into the instructor courses and into our training routines. I think they are these:-

1. Modern aircraft are easy to fly, they are very reliable and have good handling characteristics, therein lies the danger. It is all too easy to be unprepared for the rare occasions when it all goes wrong and you really have to fight for your life.
2. Other than for smoke fire and noxious fumes situations, most events do not require instant action. The ones that do are regularly practised on the simulator so that they become routine. Such things as rejected take-off, engine failure after V1 and wind-shear recovery are good examples where an instant and correct response is required.
3. For all other events there is time to assess the situation. This is absolutely vital because it is imperative to avoid the false hypothesis and to embark on the wrong course of action.
4. Know your aircraft. A good knowledge of the manuals, where to find information, how the aircraft works and what the systems do and how they do it saves time when you have to do things in a hurry, giving you more time to think.
5. If you are to assess the situation correctly you need to shed workload and buy time, therefore hand over control to the other pilot and make maximum use of the autopilot.
6. Be like a doctor. Observe the situation, diagnose the problem and then prescribe the correct checklist. Remember that the checklist is the best compendium of actions available to you. It has been thought out by people who really do know what they are talking about (the manufacturer, test pilots, the CAA, your own airline) and they will have done so in the peace and quiet of the office, where there is plenty of time to think. Remember also that for every item in the check list someone may have died for it. So follow the checklist. It is also the means of co-ordinating the crew.
7. Now comes the difficult bit, when do you chuck the checklist out of the window? Well, if it is imperative to get on the ground ASAP (it is on fire and likely to fall apart at any moment) all aircraft are still like Tiger Moths. Even in a modern jet, you only have to slow up to around 240kts and stick some flap out, slow up a bit more (say to 180kts) and stick some more flap out, put the gear down, stick down landing flap and then stick it on the runway. You won't have gone far wrong – the other bits are not essential, except for one. ***You must depressurise the aircraft before landing, otherwise you will not be able to open the doors and evacuate the aircraft.***
8. ABOVE ALL, GUARD AGAINST THE WRONG HYPOTHESIS. We all find our own routes to such conclusions; I am sure others followed a different route but came to something very similar. In my case it all came from the humiliation of being found wanting in my first real emergency.

**ADDITIONAL CONSIDERATIONS**

1. Are you aware that the first indication of stress is the onset of "Deafness"? You speak but the person you are talking to is not 'hearing' or assimilating what you are saying, though seemingly listening. Confusion is another symptom of stress.
2. When a crew member does not respond while being spoken to, it is an indication that stress is developing and that he is starting to go into a narrowing mental 'tunnel vision'.

### Comment by Captain Christopher White FRAeS.

The above incident is quite horrific and shows the extreme danger of fire or smoke **inside** the aircraft fuselage. It is imperative to "Get the aircraft on the ground as soon as possible." The modern checklists are even suggesting considering ditching as a last resort.

An interesting point has been brought up in point 7 of "What can we learn from this," - throwing away the checklist. If you deviate from standard operating procedures, you must know what you are doing and be prepared to answer for it in front of a court of enquiry. To reach this level of knowledge you should have reached the stage of autonomous learning with regards to your aircraft and its systems.

The stages of learning for a pilot: -

1. *Cognitive stage* – This is where the pilot learns how a system works, i.e. a conversion course.
2. *Associative stage* – This point is reached in the learning cycle, where a pilot now understands the working of a system or procedure and can associate it with the operation of the aircraft.
3. *Autonomous stage* – The pilot has reached the stage where he or she has a thorough understanding of the aircraft systems, procedures and also understands the aircraft's operational capabilities.

**On two occasions in my life I have thrown away the checklist**: -

1. When the rear cargo hold was on fire and would not extinguish in mid Atlantic. We had to get the aircraft down on the ground. This necessitated having to go below decision height to land in the Azores.
2. See the next Sitrep (15) "Double engine failure on take-off at Nairobi".

---

**SITREP 15 – In flight … just**

**DOUBLE ENGINE FAILURE ON TAKE- OFF AT NAIROBI**

The B747–100 did not like hot and high airfields when it had an engine failure, but on this occasion we lost two engines between V1 and V2, both on the same side, caused by bird ingestion. A flock of vultures had been feeding unseen beside the runway. As we came over the brow of the rise in the runway they became airborne just as we reached V1 and flew across the front of us. We reached our performance screen height of 35 ft. In doing so the altimeter and the VSI showed a marginal rate of climb, the first officer who was the non handling pilot, called "Positive climb" and leaned forward to raise the gear on command. I immediately said "Leave the gear." We were maintaining straight and level at V2 speed with hardly any acceleration.

Had we retracted the gear, we would have lost about 15 kts because of the drag created by the opening of the doors and the turbulent airflow around the wheel wells. We would have slowly descended into the game park. If we were going to go into the game park I wanted as much steel between my backside and the ground for comfort. We flew straight and level for many miles just above the ground. The engineer meanwhile had managed to relight one engine and we achieved about 50% to 60% out of it, even though it was shaking and making a terrible noise. We had reached V2 + 15 kts, when we then selected the gear up. We did indeed loose much airspeed, but when the gear was fully retracted we were able to climb away and eventually return to Nairobi.

Two things were done outside SOPs : -

1. Not selecting the gear up immediately on positive rate of climb.
2. Relighting a very badly damaged engine.

We are all here today to tell the tale and I had no qualms whatsoever over facing a management court of enquiry.

**QUESTIONS**

1. Was it reasonable NOT to raise the landing gear in the circumstances?
2. Should one or both engines not have been re-lit?
3. What other procedure(s) would you have used?
4. In such a situation is it permissible to firewall the live engines?

**WHAT CAN ONE LEARN FROM THIS?**

1. Where the 2-engine clean-up drill cannot be safely carried out, (because acceleration in a shallow descent is impossible, such as in this case), it is imperative to think clearly as to consequences if the checklist is to be ignored, until such time as a safe airspeed is achieved.

**SITREP 16 – In flight**

**CREW RESOURCE MANAGEMENT – BEFORE THE TERM WAS INVENTED?**

Occurrence: Loss of hydraulic pressure suggesting need to shut down two adjacent engines (out of four) on a dark and dirty night.

Aircraft type: C130 Hercules 'A' Model
Location: East Coast of Australia between Melbourne and Sydney, 10 August 1967

Only two days before the incident described below I made my first solo route flight as captain, and on the next day I made my second, both completed before dusk. These tasks were described as 'services' in which these 'A' Model Hercules of No 36 Squadron, Royal Australian Air Force, were employed to transport army, navy and air force personnel, together with miscellaneous freight between various Bases. I was an RAF pilot on an 'exchange' posting, which is to say that back in the UK an RAAF pilot was enjoying a tour on an RAF transport squadron, both of us filling co-pilot slots. I had just passed my 26th birthday.

However, as the RAAF was at this time taking delivery of the up-market 'E' Model Hercules, several of the captains in our squadron were being moved across to join the new unit, which meant that No. 36 was in need of replacements. As I had spent some two years in the right-hand seat of the 'A' Model, albeit flying in both the left and right hand seats as required, for air tests and continuation training, it was thought that I could probably cope with a command on this type. Thus I found myself on the night of the 10th of August 1967 together with a co-pilot, navigator, flight engineer and loadmaster flying the second (northbound) leg of the Richmond (our Base just outside Sydney) – Laverton (outside Melbourne) – Williamtown (a Mirage fighter Base north of Sydney) – Richmond Service. Whereas my flights on the 8th and 9th had all been completed in daylight, this one was to be flown after sunset.

The first leg down to Laverton had been entirely normal, though we had noted the line of thunderstorms beneath us as we skirted Canberra, and the rain was fairly lashing down as we carried out the turnaround at Laverton before setting off for Williamtown.

For those of you who have never enjoyed a flight in the cargo compartment of a Hercules, let me explain that it resembles a large – and very capacious – truck. Passengers are seated along each side of the aircraft on skeletal/webbing seats, with their backs to the wall. There are few windows, but you get a good view of the folks opposite, of the cargo lashed to within a few inches of your feet, and of the 'innards' of the aircraft, by which I mean the flight control rods, the electrics and the hydraulic pipes and reservoirs. Due to the high ambient noise levels that abound once the four turbo-propeller engines have been started, voice communication is thereafter all but impossible. For this reason I clambered onto some cargo and briefed our passengers on the essentials concerning our route, time in flight, destination sequence, etc. leaving our highly professional loadmaster to address the safety features.

The Hercules cruised best at about 22,000 ft, and we were nicely established at that altitude, above the weather and approaching the half-way point when we received indications of loss of hydraulic pressure in the system powered by No. 3 and No. 4 engine engine-driven pumps (EDPs) on the right/starboard side of the aeroplane. I asked my co-pilot to fly the aircraft and the navigator to monitor him whilst the flight engineer and I went into the emergency checklist.

Now the checklist required the flight engineer to offload the two affected EDPs. 'Offloading' an EDP reduced its output to approximately 10% of normal – if there was still fluid in the system: it was not possible to physically isolate or to switch them off. If a pump started to break up due to total loss of fluid, the debris that resulted might possibly contaminate that particular system. At the worst, if the pump did overheat and disintegrate completely, it could damage anything around it including fuel lines etc!

Once the pumps were offloaded, the next step was to discover where the leak might be. If this could be isolated at one EDP, then the system might be restored once the engineer had topped up the hydraulic reservoir (we always carried cans of oil for this purpose) by reinstating the 'good' EDP. To address the risk of the faulty EDP breaking apart, the checklist required that the engine driving that pump should then be shut down (and the propeller feathered). One other thing: hydraulic EDPs were all located on the right/starboard side of their host engine (looking from behind), which meant that any oil leaks coming from the pumps might not be seen.

So our athletic engineer (he had to be, to scale the cargo and access the reservoir) topped up the affected reservoir and returned to his seat between and behind the two pilots. He had briefed the loadmaster on what was occurring and got him to monitor our discussions on his headset via his long lead, and to report any evidence of fluid leaks around the undersides of the engines. At this stage, none had been observed.

The engineer then, having checked the reservoir contents on the gauge, reinstated the EDP on No 3 engine, whereupon hydraulic pressure returned for a brief instant then fell away whilst the contents gauge rapidly returned to zero. Could it be luck that had enabled us to identify the faulty pump first try? The next stage was for the engineer, having again offloaded the No 3 EDP, to return to the cargo hold and once again top up the reservoir, following which we would reinstate the No 4 EDP, shut down the No 3 engine and proceed with the problem nicely contained.

It was not to be, for when the No 4 EDP was reinstated, once again the pressure built for an instant before dropping off as the contents gauge returned to indicate 'nil'. It appeared that both EDPs were now running dry, or with very little fluid in them, and I was faced with the question as to what to do next.

There was no checklist to cover our perceived situation, i.e. loss of **both** EDPs in one system. Should I shut down both No. 3 and No. 4 engines, should I keep one going and shut down the other, or should I keep both of them going? With one engine shut down, we would have to descend a couple of thousand feet, but could remain just above the tops of the thunderclouds, but with both secured, we would be right amongst the icing, the turbulence, the hail and the lightning – not a welcome prospect.

Now, although I thought I knew what I should do, I first put the question to our co-pilot, who was the least experienced although he had sufficient technical knowledge, and received his answer, before I turned to our flight engineer, whose previous experience as a Hercules airframe or engine mechanic well equipped him to make a sound contribution. Happily, they both voiced what was in my mind: shut down the No 3 engine but keep the No 4 going, remain above the tops of the clouds and search out a suitable airfield to which we could divert.

At this point, our navigator suggested that we should make for Richmond – our home base – since it was both the closest and the weather there was not too bad. Accordingly we declared an emergency and landed on three engines at what was then about 1030 at night.

My Squadron Commander came on board as the last propeller slowed to a halt and asked why I hadn't shut down both No. 3 and No.4 engines! He didn't wait for my response, but told me to see him at 1100 am the next day. Of course the thought now going through my head was, 'Did I make the right decision? Should I have shut down both after all? When we had stopped on the ramp, I had been confident that I had managed the incident correctly, but now I really wasn't so sure!

Well, it isn't often that angels smile upon me, but they did the next day, for before I went before the boss, I saw that there was a newly-arrived paper amendment to the Dash-1 (aka Pilots Notes / Flight Manual equivalent) that contained A BRAND NEW EMERGENCY DRILL FOR LOSS OF TWO EDPS IN THE SAME HYDRAULIC SYSTEM! And what it said, crucially, was '**Shut down only one of the affected engines'**. So what my crew had advised me to do, and what I had taken the decision to implement, was vindicated!

**QUESTIONS**

1. If you were the aircraft commander, would you have done anything differently?
2. Do you 'mug up' on technical points only just before a routine check or training session, or do you make opportunities at other times to freshen up your knowledge?
3. Does your employer arrange for routine technical refresher sessions, where the lecturer can answer those questions that have been in your mind for some time but you felt a little too self conscious to ask training pilots? If not, could it be arranged?

**WHAT CAN ONE LEARN FROM THIS?**

1. When you see that a problem has arisen, get the crew to help you make decisions that will result in a successful outcome. You may know your own mind, but other professionals alongside you or in the cabin can almost certainly contribute positively to your knowledge and so better inform the decision you, as aircraft commander, must ultimately make.
2. In most circumstances that involve transport aeroplanes, you will have sufficient time to think the problem through before taking action that changes the nature of the flight, e.g. commencing a diversion, moving the aircraft from a 'normal' to an 'abnormal' state, etc. Think ahead: What if there should be a further deterioration in the aircraft state, causing the 'abnormal' state to become an 'emergency'? Modern passenger-carrying civil aircraft have considerable redundancy built-in, whereby loss of one hydraulic system (of maybe three) doesn't require an immediate diversion, but what if a second should fail? Where now will you divert to if you have elected to continue following loss of the first? (What precautions could I have taken to guard against sudden failure of and possible fire in the No 4 engine, which I had kept going?)
3. In my experience, about half of the serious in-flight problems I have encountered have not had drills in the 'abnormal' or 'emergency' checklists. To compensate, it is of some comfort to have a good knowledge of the aircraft and its systems, and to know where to turn for information when this is needed. Conversion training and routine competency/proficiency checks will never cover every eventuality. As happened to me, the first serious problem you encounter may come all too early after you have converted onto a new type or been given a command. Be prepared!

---

**SITREP 17 – In the air & on the ground**

**MEDICAL EMERGENCY**
From a newspaper article by Claire Coleman - Daily Mail, 1 Aug 2006

Hundreds of thousands of people will be flying-off on their summer holidays in the next few weeks. For most, the greatest worry will be flight delays and, perhaps, lost luggage.

There is always the fear, of course, of succumbing to some ghastly travellers' bug once you reach your destination. But we don't expect to be struck down on the flight itself and while the prospect of being trapped miles above-ground without professional medical help is daunting enough, when Caroline Clarke's husband fell ill on a long-haul flight, it was just the start of her nightmare.

The real problems began when the pilot decided to offload them in a notoriously dangerous African country, miles from any proper medical facility.

In April 2005, Caroline Clarke, then 57, and Philip, 60, were coming to the end of a four-month stay near Cape Town. Caroline's mother was South African and they had spent many holidays there.
But about four weeks before they were due to return to the UK, Philip developed what he thought was mild 'flu'.

'He had a headache he couldn't seem to shake off so he went to see the local GP, because in South Africa there's always a niggling worry that you might have been bitten by a mosquito and contracted malaria, says Caroline.

'The GP did various blood tests but they all came back-negative and he thought it was probably just a virus. Philip was always a very healthy person, very fit and active.'

However, on the day the Clarkes were, leaving, Philip was still concerned about his headache and went to the Doctor again. He was told he was fine to fly and in fact, the best thing was to get home then, if it didn't clear up, see a GP in Britain.

About three hours into the flight, Philip became very disoriented. He did not seem to know who or where he was. He kept trying to get out of his seat and up the stairs the back of the plane,' says Caroline.

'I tried to explain to him that we were on a flight back to London but he did not seem to understand. It was frightening and he became more and more difficult.

'An air stewardess took me off to have a coffee while one of her colleagues tried to calm Philip down. I just kept thinking he must have had a stroke.

'One of the crew put out a call asking if there was a doctor aboard and a Canadian GP came down and looked him over. But she didn't seem to have any idea what was wrong with him.

Then the purser came out to say they had made radio contact with the airline's medical advisors, who suggested the plane land so that Philip could be taken to hospital as soon as possible.

The captain came along and said we were going to set-down in Nigeria in a place called Abuja,' says Caroline. As soon as he said Nigeria, I just thought: "Please, no,".

I had never been there and only knew what I had heard about the place. Not only was I frightened of going there, I instinctively felt that we would not find-the facilities we needed. But the captain was resolute and had already set course for Abuja.'

The plane landed at 3 am and when the paramedics came aboard, they suggested sedating Philip so the couple could fly on to London.

'But the pilot wouldn't listen,' says Caroline. He wanted us off the plane. So we were dumped on the runway with nothing but the clothes we stood up in, a mobile phone with almost no battery life, my wallet and our passports.

'Everything we had was in the hold and although the flight staff tried to find our suitcases while the plane refuelled, it was like looking for a needle in a haystack.

'We'd been told there would be Company's ground staff available to help. There was a taxi waiting, but there didn't seem to be anyone else around.

'Immigration took away our passports, telling us we needed temporary visas to get into the country and after waiting for two hours we finally began what we'd been told was a ten-minute trip to the hospital.

'The journey was terrifying. The driver was going 80 mph along tiny roads and after 15 or 20 minutes we still had not reached civilisation.

'When we finally made it to the medical clinic we were shown into a room with two beds and I was told that I would be looking after my husband. Given the difficulty I had had restraining him up to that point, this was a terrifying prospect.

Caroline managed to contact one of her sons, who rang the British Consulate in Abuja. Meanwhile, Philip's condition was deteriorating.

‘He was increasingly disorientated and hyperactive,' she recalls. 'He kept dressing and undressing himself falling over and trying to escape; He wouldn't sleep and we were still no nearer a diagnosis. ;

Worse still, my fears about Nigeria had been proved right. The clinic gates were manned by armed guards and the Consulate warned me not to use any credit cards as the country was so corrupt that the safest way to buy anything was to use cash.

This became a problem when the clinic insisted that unless they received £1,000 by 5 pm that day, they would throw the couple out. The Foreign Office instructed the Consulate not to release the funds until they had received the cash in the UK.

‘So, on the Saturday of a bank holiday week-end, my sons in the UK were trying desperately to raise the cash and deliver it to a police station in time,' says Caroline. 'It was an absolute nightmare.'

To compound her problems, the couple's travel insurance had just expired. 'We'd extended our holiday and I'd forgotten to extend the insurance,' she admits. But I knew we had to get back to the UK as soon as possible and for that, the Airline we were flying with when we were off-loaded at Abuja, insisted that Philip be accompanied by a doctor.

The same demands for cash were made and amazingly, on the Sunday, her sons found the requisite £3,000 for the flights.

Caroline recalls: 'The cars that took us to the airport had guards with machine guns on board, which terrified me.

We had to tie Philip into the seat to keep him there on the return flight, arid on landing at Heathrow we were met by a private ambulance that my sons had chartered.

Once in Britain, a CAT scan showed Philip was suffering from a brain tumour that Caroline was subsequently told was inoperable. He died a month after their return from Nigeria.

'For months, I was too numbed by the shock of what had happened to think about trying to seek an explanation from the airline Caroline says. 'But everyone I spoke to was so horrified by the airline's decision to leave us in Abuja, that in January this year, I wrote to the Airline’s chief executive.

'What is the point of leaving a sick person in a place where there are no proper medical facilities and no nursing staff? No one else should have to go through the nightmare that we did.'

The European International Airline at the centre of this story says any decision like this is made based on advice from their tele-medical service. According to the Consumer Protection Group which is the passenger arm of the Civil Aviation Authority, the Carrier’s actions were within their guidelines.

'In the event of a passenger falling ill, the commander of the aircraft has every right to make a decision on where to land,' a spokesperson told Good Health. It is customary policy to make a decision to land at the nearest airport if practical.

Simon Evans, chief executive of the Air Transport Users Council, says that while the airline may have been acting according to protocol, he would have hoped they might have shown a little more consideration. It is just one of those areas where you hope that common sense and common decency prevail,' he says.

In the light of the Clarkes' experience, the operator has ordered a review of all 77 medical diversions undertaken by the airline in the past two years, with the aim of reviewing the current policies and procedures.

However, in a letter to Caroline Clarke, the airline’s chief executive warns that : ”While it is not possible to prejudge the outcome of the review, I remain mindful of the fact that there may be circumstances where a decision not to divert into countries such as Nigeria could lead to the loss of a life that could otherwise be saved”.

**COMMENT**

This disidentified case-history is offered ‘as reported’, so that readers can judge for themselves.

**QUESTIONS**

1. Would you have diverted to this airfield?
2. Would you knowingly put a passenger in such jeopardy?
3. With the current security arrangements that are in place, passengers do not have much with them, since all their belongings are in the hold – would this be consideration as to making a diversion or continuing?
4. In the above case, might you be considered liable had the passenger been harmed?
5. If a diversion is essential – what is “A suitable airfield” ?
6. Do the passenger’s requirements need to be taken into consideration in a medical diversion?
7. Might it be better in this case to over-fly, until reaching a European country?
8. Would the protocol at immigration, the hazards and the journey to the hospital have taken the same time as continuing to a safer area?
9. What do you feel about the decisions made in the above case?

**WHAT CAN ONE LEARN FROM THIS?**

1. It is very important for the captain to look at the global overview, when being fed information from home base. The 'operations officer' on duty might not be aware of what conditions are like locally. Any suggested course of action must therefore be treated with caution and decisions made only after the situation is assessed on the spot with local help, having taken all possible variables into consideration.
2. Captains must learn to use their common sense and make their own informed judgments. Use GRADE or DODAR techniques, as discussed in Part 3.

---

**SITREP 18 – In the air**

**REMAIN ALIVE TO WIND-EFFECT DURING APPROACHES**

We were on a late final approach to Runway 23L at Dusseldorf, with the co-pilot landing our Boeing 767-300ER in short-haul configuration. There was an unstable air-stream, clear and smooth around the field but there was a CB about 5 miles away to the NW. The actual wind reported was Moderate and right down the runway. At about 75 feet, the IAS increased abruptly by about 20 kts. I took control. In my mind I was confident that I could maintain the approach path and bring the speed comfortably within limits by retarding the throttles, while keeping in mind that I should aim for something above Vref to avoid reaching a high attitude at a low airspeed. In spite of my intellectual process, while my left hand maintained the approach path, my right hand advanced the throttles. The landing was good, excellent in the circumstances, a couple of knots above Vref, but with the throttles at high power. I closed the throttles and selected reverse and we stopped without any problems. This model of 767 has a great deal of power excess in short haul operation, and I used a lot of it in what was probably a downburst, although it was in clear air.

**QUESTIONS**

1. It is often said that any landing you can walk away from is a good one. This landing was superficially a good one, but was it ?
2. Should I have called a go-around?
3. Should the co-pilot have called for a go-around?

**WHAT CAN ONE LEARN FROM THIS?**

1. Napoleon is reputed to have sought luck in his commanders. I favour golfer Gary Player as the originator of "The more I practice the luckier I get". Captains need all the luck they can scrape together, so take every opportunity to practice. Automatic systems do not need practice and practice in the use of them on the line has limited benefit, since the practice most needed with such systems is in the failure cases, which are very rare in line operation.
2. Taking over from the automatics late-on is something worth practising from time to time. Co-pilots need practice too, but your prime responsibility is to maintain your own standard. I have no doubt that many years of short-haul operation with a dozen landings a month, even as a co-pilot and in quiet times, had stood me in good stead in the above event and others, either in short haul or long haul operations.

---

**SITREP 19 – In the Air**

**ENGINE FIRE & NOSE WHEEL LOCKED UP**

When we do our simulator checks we always have to practice engine fire drills and explore different scenarios of systems failures. Over a few years, it can become somewhat routine and even easy. When it happens in real life, it can be rather a different story and a simple failure can have far reaching consequences.

Taking-off in a Trident from Stavanger one lunchtime, the co-pilot (P2) was the handling pilot. We had just passed 2000 feet and were accelerating when No 1 engine fire warning came on. Unlike when on the simulator, I simply could not believe that this was happening; nevertheless, the training kicked-in and while the P2 continued to fly the aircraft, I and the third pilot (P3) completed the memory items of the fire drill. The fire did not go out. So, very carefully, we went through the drill again and fired the second bottle.

The fire continued. This was serious, and not at all like the simulator.

I told P2 to turn West so as to put the aircraft over the sea, to maintain 3000 feet and 220 knots and engage the Auto-Pilot. I next called the Chief Steward to the flight deck and he needed no telling. "How long?" was all he asked; "five minutes max", I replied, and he got on with his job. I declared a Mayday and requested radar for landing on Runway 18, the one which we had taken off from. I then asked the P2 to take over the radio communications and look after the aircraft.

The P3, meanwhile, had started the checklist for a fire that does not extinguish and I joined him half way through. We had to offload the hydraulics for the burning engine, but this meant that we would have to lower the gear manually via two levers under a hatch in the cockpit floor. We lowered the main gear successfully, but when it came to the nose gear it wouldn't budge.

We were now faced with an engine on fire, no nose wheel and Air Traffic Control radar helpfully turning us in to quite tight finals. The P2 asked for an extension downwind to give us time to think, though I was also aware of the pressure presented by the burning engine.

I left the P3 with the new problem while I warned the cabin crew of the added problems for landing and started the landing checks just to make sure that no other problems would be created by missing-out essentials. The P2, meanwhile, had accepted a turn on to finals and had locked on to the ILS. The P3 advised me that he had done everything he could but the nose wheel was still locked up. The cabin crew reported all ready for landing and I advised Air Traffic Control of the new situation.

At 1500 feet we were set up for an emergency evacuation after a rather noisy arrival.

At 1000 feet, the fire went out, we on-loaded the relevant hydraulics, the nose gear came down and we achieved a normal landing, sort of … some 8 minutes after the fire warning had come on.

**WHAT CAN ONE LEARN FROM THIS?**

1. Always take your simulator Checks and Refreshers seriously. Few real emergencies follow a pattern and when you are going through the thought processes, try to think through the first stage and think “what if” just in case the first solution doesn’t work.
2. Good CRM is vital. Co-pilots should be prepared to use their initiative and judgement if you see that your Captain is becoming over-loaded. Captains can breed an atmosphere in the cockpit where your co-pilot will think ahead (P2 asked for an extension to the circuit when he realised that there was an additional problem).
3. Give yourself time and try not to get rushed into a situation of accepting such an approach, if you are not fully ready.
4. Remember that there are other checks to be done, either during or after the emergency ones. Doing them properly may save an expensive omission

**COMMENT**

The moral of this story is quite involved.

1. Checklists are there to lead and guide, but sometimes you have to think ‘out of the box’. We had decided that we would on-load the hydraulics at 500 feet to lower the nose gear, even though this might have caused a hydraulic fire as well … Incidentally, the fire was genuine.

---

**SITREP 20 – On the ground & in the air**

**HYDRAULIC SYSTEM FAILURE**

A gloomy winter’s day and three of us were due to operate a four-sector day from London Heathrow to Prague and Budapest, returning the same way through Prague. The aircraft was a Trident 2 and was in good order.

On arrival at Prague, one of the hydraulic systems was found to be unserviceable and we were therefore obliged to consult the Minimum Equipment List (MEL). The Trident had three systems: Green, Yellow and Blue, of which the primary ones were Green and Yellow, the Blue one having relatively little to do but could be used to cover the functions of the other two in the event of a primary system failure. There was an additional system for the “in extremis” scenario, which involved a Ram Air Turbine (RAT). This could be extended into the airflow and fulfil the functions of one selected system.

The MEL stated that we could continue with the Blue system unserviceable, provided there were no other failures in the other two systems. This was no problem, so we continued with the rest of our day.

On the sector from Budapest to Prague, the P3 commented that the Yellow system seemed to be operating at a rather higher temperature than the Green one, though it was still well within limits. On the descent into Prague, it returned to nearer a normal reading, though still remaining higher than it should have been.

We now had a dilemma. This was 1979; Prague was still behind the Iron Curtain, the aircraft was full, it was winter and there would be no hotels available if we night stopped. Furthermore, it would take some time for the system to be changed and the work would have had to be done in the open.

In fact, we did not have a problem ‘per se’ … merely a potential problem if the Yellow system continued to give trouble.

Between the three of us and the station engineer, we discussed the problem thoroughly and decided to go; the en-route weather was good, as it was at all the potential diversion airfields and London had improved.

We also thoroughly discussed the “what / if” situation and what we would do if the Yellow system were to fail. Under the circumstances, I asked the P2 to do the flying back to London so that, in the event of a diversion, he would already be in control and “up to speed”. (In an emergency, the SOP was to hand over control to the co-pilot so that the Captain could manage the flight).

Some 20 minutes after we reached our cruising height of FL 310, the P3 advised us that the Yellow hydraulics temperature was rising again and while it settled for a short time, it then started to rise quickly while the pressure started to fall. Within minutes, it had overheated and it was clear that the pump was in distress, so the system was offloaded. With Green system doing all the work, it too was starting to warm up so we lowered the RAT and switched it to run those systems formerly operated by ‘Yellow’.

Meanwhile, the P2 declared an emergency and prepared for the landing at Frankfurt, where runway 25R was nicely positioned, 120 nm ahead of us.

We landed some 15 minutes later.

**COMMENT**

Why did it work so well?

1. We had taken into account all the possibilities of the "what if" situation. We had planned the various alternatives and both Co-pilots were fully involved in the decision process. Had one of them been unhappy, I would have aborted the flight. Always discuss things with your crew and respect their reasoning, no matter how new or junior your co-pilot is. He might have thought of something you haven't.
2. The weather was on our side all the way and is always an important consideration.
3. The P2 was fully briefed on the ground in Prague should a further hydraulic problem occur. In fact he declared the emergency without being instructed to do so, while the P3 and I were analysing the problem and its repercussions. By leaving someone to cope with the aircraft as we did with the P2, it allows him to monitor our activity and act quickly if he has to.
4. We stuck to SOPs.

---

**SITREP 21 – In the Air**

**WRONG RUNWAY**

It was one of those lovely Sunday afternoons in Summer and we were operating a flight from London Heathrow to Lyons. This would be one and a half hours each way and I was feeling very relaxed, since this was my first trip without a trainee for over a month. True, my co-pilot that day was new on the type (B737) but we had often flown together on a previous aeroplane type and I felt no pressure. He had never been to Lyons, but I had been there two or three times so I flew the first leg.

Now, in our Company we had SOPs which stated we flew the "monitored approach" whereby the co-pilot would do the let-down for me and I would take over at a suitable time on finals and land. We also had a proviso that we could ignore this SOP if the weather was good and at Captain's discretion.

It was such a lovely day that I suggested we cancel SOPs that day so that he could have a good look at the lie of the land at Lyons, in order to become familiar. In addition, I asked the co-pilot if he would mind me doing a manual letdown and approach. No problem, he said.

As we descended under radar control, ATC warned us of numerous gliders (it WAS a Sunday) and my co-pilot was kept busy doing the R/T and keeping a lookout. I noticed the pressure starting to build up on both of us, to the extent that I put the Auto Pilot back in.

By the time we were at 5000 feet above ground level, we were both working hard and ATC asked us to call the field in sight. "It's just over there" said my co-pilot, pointing ahead. I looked up briefly, saw the R/W and lined up on it. Something wasn't quite right; the ILS didn't add up even though I had identified it, and we told the tower we were on finals. Silence for a few seconds, and he then said "Confirm on final? I do not have you in sight".

Well, you've guessed it --- wrong airfield! I had lined up on the R/W at the military base some 4 miles to the West of Lyons. A gentle go-around from 1500 feet and we went off to the correct airfield where we landed a few minutes later, much chastened by the experience. No one noticed down the back.

**SO WHAT WENT WRONG?**

1. There is a good reason for SOPs; they have been evolved over many years and have stood the test of time.
2. Yes, there might be times for alleviating them, but a Captain should not simply consider the weather, which was good in this case, but also the terminal traffic such as the gliders we encountered. For instance, had it been a weekday with no gliders flying in the vicinity, there might not have been the same pressure on us.
3. The Auto Pilot relieves workload and though I re-engaged it when the workload increased, it was too late to hand the aircraft over to my co-pilot, since I had allowed an atmosphere of high pressure to develop.
4. Though I had identified the ILS, it didn't line up when I though we were on finals. Though my mind had already started to question the scene, I had been working hard and there wasn't enough brain left to quickly work out precisely what wasn't right and why. (A runway in front of you is very compelling). My co-pilot was very busy with checklists and the R/T.
5. Always trust your senses; if something doesn't add up, as in this case, voice your concerns. If it doesn't look right, it probably isn't.
6. Stick to SOPs unless you have a very good reason not to. They are there to make your flight safe.

---

**SITREP 22 - On the Ground**

**DC8 OPERATION WITH UNSERVICEABLE COMPONENTS
& USE OF MINIMUM EQUIPMENT LISTS**

This event occurred to a Captain X prior to departing on a DC8, for a route check flight from Montreal (YUL) to London Heathrow (LHR). It was to be carried out by captain Y, a senior company ‘check pilot’. The aircraft arrived from Toronto (YYZ) with an unserviceable No 3 generator, as entered in the technical log by the inbound Captain. The outgoing ‘check pilot-examiner’ consulted the MEL and declared they could go.

Captain X who was on his annual route check, disagreed and said that as they were at a Company main maintenance base, the generator should be changed and that he (X) was not going to fly in a sick airplane at night or by day, over the Atlantic to LHR. This caused a certain amount of consternation, at which point ‘Check pilot’ captain Y said he would have Captain X replaced as he (Y) was prepared to operate the flight with the unserviceable generator.

Captain X told him to go ahead, but that it would take up to two hours for a replacement Captain to be called out and report for duty, but only 40 minutes to change the generator. Grudgingly, ‘Check pilot’ Y agreed that number 3 generator should be replaced and this was done. In the event, the Flight departed 45 minutes late but with four serviceable generators and no deferred defects in the technical log.

As luck would have it, at about 40 degrees West, number 1 generator failed. Had the flight left YUL on 3 generators it would have been over the Atlantic on 2 generators, at night and in inclement weather conditions.

At this point, ‘check pilot Y’ had the grace to turn to Captain X and jokingly say something like, “you must have a crystal ball but were right to say ‘NO’ to a 3 generator operation”. In the ensuing conversation Check pilot Y was brought to the realisation that the MEL is only a guide, which needs to be interpreted by pilots and both now agreed that the MEL was not just to be used to keep an aircraft moving, simply to remain on schedule.

Clearly, Captain X’s common sense and professionalism won the day.

Finally, the Service arrived at destination only 20 minutes late, due to favourable tail-winds over the Atlantic that night.

**COMMENTS**

1. Acceptance for dispatch of an aircraft with an unserviceability, limitation or defect, listed in the MEL, is entirely at the discretion of the captain. It is he who is best placed to know what can be expected on the flight or series of flights that lie ahead. For example, day/night VMC/IMC, in-flight icing, avionic aids required for RNAV/RNP, performance-limited runways, etc. (See Part 2, Section 3 at 3.4).
2. It is your responsibility to take an aircraft into the air, despite MELs.
3. The Captain's responsibility goes beyond the MEL. The MEL cannot take into account every set of circumstances, but the Captain has a duty to do so as far as is possible. Captains must be aware that the acceptance of such MELs and DDMs is their responsibility, not ‘Maintenance’ or ‘Dispatch’. Remember the law; it is a captain’s responsibility to decide if an aircraft is fit to commence a flight.

---

**SITREP 23 – On the Ground**

**A VERY DIFFICULT SITUATION**

One morning, as a relatively inexperienced First Officer, I was required to challenge my Captain’s fitness to fly. We had flown together only once previously, when he had acted in an erratic and distracted manner, completely unlike any other Captain I knew. On that occasion I had monitored him particularly closely in flight, later discussing the experience informally with my flight safety officer.

On the morning in question, I was first alerted to his potential unsuitability by the cabin crew. I continued my flight-deck preparations while the Captain conducted the external inspection and refuelling. However, the cabin crew were making known their increasing unhappiness and soon were being supported by the dispatcher and other ramp personnel.

I tried to reassure all these people before the Captain returned and I then started to prepare discreetly a contingency plan. In anticipation of the worst outcome, I was forced to inform company operations of the developing situation so that a stand-by Captain could be called-in at very short notice, if required. Passenger boarding was imminent and I advised the dispatcher to continue with the boarding, in case there was no problem actually. However, I reassured my colleagues that, if upon closer scrutiny I had any doubts at all, I would express these to the Captain despite the risk of confrontation.

I was faced with a dilemma: If I questioned my Captain’s suitability to fly, he might not co-operate, thereby forcing me to refuse to fly, based upon a view which although shared by others, might be wrong. Alternatively, if I decided he was fit to fly with, but I was wrong, flight safety would be compromised. I was facing a totally avoidable situation, given the concern already expressed; and the possibility that the cabin crew might also have refused to fly (which I later discovered had been their intention).

My final assessment was that my Captain was unfit. I asked him how he felt and when he said, “fine” I explained that I thought he looked unwell and that despite a looming departure time, it might still be sensible to declare himself unfit. He then admitted to feeling unwell but made no indication of whether he therefore wanted to press on or otherwise. I expanded, saying that it was not only my judgement and that, in addition, questions might be asked if the incapacitation scenario arose. He finally agreed with me and declared himself unfit to fly, albeit with passengers now boarded. Whilst awaiting the arrival of his replacement I kept the passengers and crew reasonably informed without going into details.

In retrospect, I think I managed the situation well by listening to the input of others, by considering all possible outcomes, by contingency planning, and by being assertive when necessary.

**QUESTIONS**

1. Would you have handled the situation differently had you been faced with a senior captain giving you a route check? … For example?
2. If so, how?
3. Would one need to be more forceful in similar circumstances? … If so, in what way?

**WHAT CAN ONE LEARN FROM THIS?**

1. In such a situation, it is not possible to accuse someone of being ‘under the influence’ of either drink or drugs, unless this is established by a police officer or a doctor, following accepted tests for the condition. Prescription drugs have been known to cause impairment to some extent and this must also be considered before any drastic action is taken to stop the person from remaining on duty. Careful questioning might explain irrational behaviour, which might be caused by taking prescription drugs such as anti-histamines. The person concerned could be made to voluntarily ask to be stood-down in the circumstances, with no further action taken other than to make him or her aware of the dangers of alcohol and/or drugs affecting operational performance. There are hidden dangers in using Prescription drugs, such as anti-histamines and many of the common cold remedies, which produce side effects that might interfere with flying efficiency. These drugs are widely prescribed and used without the full realisation of the restrictions on their use by flying staff using such drugs and then flying. This subject could also be usefully discussed with those whose behaviour seems irrational and raises concern.
2. Pilots are subject to a much lower alcohol limit than motor car drivers, before being considered as being unfit to operate their respective machines.
3. The event illustrates the difficulty that a co-pilot may find himself in when challenging his Captain’s authority, whether in a situation such as this one, or in an operational situation in his capacity as a professional; who is there to fulfil the ‘backstop role’ in an emergency. The need for diplomacy and careful handling, coupled with a firm but polite challenge as in this case, may need to be used in the face of unusual circumstances.
4. However new to the role, crew members must challenge abnormal behaviour and be prepared to act, such as taking-over if necessary in any case of incapacity of the other pilot. For example, it may be imperative to call for a go-around if an approach is being conducted in such a manner as being outside accepted tolerances. This needs moral courage and maybe immediate appropriate action from the other pilot, if an accident is to be averted.
5. Numerous instances of positive non-intervention from other crew members have resulted in dreadful accidents, such as the Tenerife crash when a B747 started take-off without ATC clearance. The first captain had misunderstood the airways clearance given and commenced take-off in the fog, unable to see another backtracking B747. This was still on the runway and on the way to the exit it had been cleared to, but invisible to the first aircraft taking-off in the prevailing 300 metres of RVR. The captain continued the take-off, regardless of the weak protest from both the flight engineer and the first officer, who was flying with his chief training captain and of whom he was clearly awed and afraid of. They collided with the back-tracking B747, which had been cleared to taxi back on to the active runway in fog. This back-tracking aircraft was supposed to have exited the runway half-way down, as instructed by ATC, to then continue taxiing on a parallel taxiway. It had not reported clear (so what was going on with the ATC flight control strips?) when the first aircraft commenced take-off. Both aircraft were destroyed, with major losses of life.
6. The bottom line is that the safety of a flight rests in every crew member regardless of rank. If you do not like something that the other person is doing regardless of his rank, never be afraid to speak up. Stand up and be counted at all times, with discretion but firmly.

**COMMENTS**

There can be a variety of reasons for erratic behaviour. Intoxication may be the result of prescription or non-prescription drugs taken quite innocently. A person who appears intoxicated may in fact be suffering from a medical condition, known or unknown. In this context fatigue and stress are medical conditions. Comments must therefore be confined to the facts of the behaviour which has caused concern. Having raised the issue it cannot be assumed that an improvement in behaviour, if one is apparent, will continue. So the decision to allow the person to continue the operation should only be taken after very careful consideration and probably after a medical examination. Insisting that the problem is dealt with, even if this involves a refusal to fly with someone who believes that they are fit, is in fact in the interests of everyone involved; even the unfit person. It is far easier to assist someone with a problem, even a substance abuse problem, if it is brought into the open before a serious incident occurs in flight.

On one occasion, a pilot behaved very erratically and was subsequently diagnosed with a brain tumour. In this case he was not only unaware of a problem but was unaware that there was anything wrong with his behaviour. This emphasises the point being that one can only comment on the observed behaviour and not on the possible reasons for it.

---

**SITREP 24 – In flight**

**MANCHESTER TO ROME - A BAC 1-11 FLIGHT IN 1974, OR WAS IT '75?**

The duty day commenced with a departure from Dublin, but the flight had to make a technical stop in Manchester, due to a refuellers' strike and insufficient fuel to fly non-stop to Rome. Although the co-pilot was inexperienced it was the captain's practice to share the flying 'leg and leg about', flying the first leg himself and so setting the tone. Both the en-route weather and the destinations and alternates weather were good. So the Captain proposed that the co-pilot fly the second sector that day.

At Manchester the passengers were kept on board for the refuelling. The ship's papers for the Manchester departure had been pre-prepared and an ATC flight plan filed in Dublin. So the departure had been facilitated and the delay minimised. No further destination weather information had been requested or received in Manchester.

The flight over the Alps and down towards Rome was uneventful, although a significant amount of time had been lost compared to the Original Flight Plan (OFP), but not enough to invalidate the use of Pisa as a destination alternate, the other being Rome Ciampino. The initial Volmet broadcast indicated changes to the weather. Pisa, which had been forecast as showers with cloud shown on the Significant Weather chart was better, while at Rome Fiumicino, the weather which was expected to have clear skies, had now become cloudy. However, these weather changes signified little operational significance at that stage of the flight.

Over Pisa the skies were clear and the captain speculated that the cloud and showers must have moved south towards the Rome area. The ATIS for Fiumicino, when first received, indicated a considerable change, with cloud, rain and a strong cross-wind for landing on Runway 16. The co-pilot expressed concern that, as the cross-wind was on limits, the captain might wish to carry out the landing. The captain countered by saying that they should wait and see. In fact this uncertainty was soon resolved when Fiume Approach control cleared the aircraft to proceed via Tarquinia and Campagnano (CMP) for a localiser approach and landing on Runway 25.

On route to CMP the weather radar showed a narrow continuous line of echoes on a NW-SE alignment, with no way through or around and which would have to be crossed to get to the VOR. Now the x-band 'Ekco' radar on the 1-11 was very sensitive and effective at short range. On this occasion, the echoes did not contour and there were no reports from ATC or other aircraft of weather or thunderstorm activity. In fact, the frequency was eerily empty of other aircraft. An Ethiopian 707 was the only other aircraft being handled.

As the cockpit darkened, the turbulence was little more than light, but then the two front windscreens were vividly lit up all over with St Elmo's fire. The noise in the quiet 1-11 cockpit increased a little as the soft hail/snow pellets impacted the windscreens. The co-pilot had never seen St Elmo's fire; but to the captain it was 'old hat', having slogged through winter weather at low altitudes on night cargo and mail flights on DC-3's. After the Captain's reassurance, the aircraft was quickly flown through the line and continued its descent towards CMP.

Procedurally, the flight was required to depart CMP on a radial of 210° and the co-pilot turned onto the heading. He needed encouragement to turn further to close the radial because of the wind. Unfortunately, this took the flight back through the weather. Having gained the radial and cleared the line of weather, Approach Control gave a vector which took the flight back through the weather line for the third time. Having been given a descent from 9,000 to 6,000 feet, heavy rain, now beating on the windscreen, considerably increased the noise level making communications more difficult. Being unsure of Ethiopian's altitude, ATC directed the flight to climb back up to 9,000 feet and then after a short period a turn onto the localiser and descent were given, but with the consequence that the aircraft was now positioned maybe 4,000 feet too high on the landing approach profile; and yes …, back through the weather for the fourth time!

By this stage, Pisa had become problematic as an alternate because of its distance, whilst Ciampino was still under the weather line and not an inviting prospect as the second alternate.

As the 1-11 in the 70's was equipped with only one DME on the No 1 'Nav' set, this would have to be selected to the Ostia VOR/DME, which was on the Runway 25 centreline, but beyond the field and the distance to Runway 25 threshold would need to be mentally calculated. The No 2 'Nav' set would be tuned to the localiser so that the co-pilot could then fly the approach. The configuration had been briefed, the MDH determined and the cloud base was above minima, but not by much.

But how to loose up to 4,000 feet of excess height? This hadn't been part of the much earlier briefing scenario. It could not be dived off; while the speed brakes on the 1-11 are useless. The high descent gradient required could only be achieved by a configuration giving maximum drag, which was set up by lowering initial flaps, then gear and full flaps in sequence, as speed was reduced. Maintaining speed at the target approach speed or a little above, the ROD was 'off the clock' and the nose down pitch angle very steep. This was beyond the experience of the co-pilot, who needed direction to get the nose down at the start of the descent to achieve the necessary descent gradient. As the descent path slowly converged with the standard DME based descent profile (1,000 feet per 3 nm), the thrust was increased and the aircraft duly stabilised on this descent path. The runway was sighted just over one hundred feet above the MDH.

The aircraft was on the centreline and landed in light to moderate rain with a headwind of 10 -15 knots on Runway 25 which was awash.

**QUESTIONS**

1. A very few WW2 pilots never gave a leg to the co-pilot, some captains offer the 'easy' legs while most captains share the flying equally with their co-pilots. When you are established as a captain, what practice would you follow?
2. JAR-OPS require an operator to have a policy/procedure to avoid inexperienced pilots being rostered to fly together. Many airlines provide additional guidance/conditions which restrict the conditions under which they allow co-pilots to fly; usually depending on their experience. Are these reasonable constraints and, as a captain, would you stick to them?
3. On this flight, when the co-pilot felt that maybe the captain should perform the landing, would you as the captain have taken over the flying at this point?
4. When the co-pilot is flying, occasionally the captain will maintain a continuous flow of instructions, criticism and even abuse. Is this acceptable? When you have given the co-pilot the leg, do you think you should give any directions about how the flight should then be flown? On this flight the captain made two specific interventions – to track the radial out of the CMP VOR and then maintain a high descent rate/gradient on the initial approach. Were these justified and essential in the circumstances?
5. A decision is often/sometimes projected as singular and taken at a moment in time, but often it is a process involving a series of decisions over a period of time, as conditions change. Can a decision be taken too soon? Can a decision be reversed? On this flight, what decision(s) would you have made, and when?
6. On this flight, the developing situation has been characterised as one of being 'sucked in'. This is usually/often the consequences of a sequence of decisions or indeed non-decisions, or external actions taken by others; in this case, the Ethiopian 707 and the Approach Radar. How do you break such a sequence ?
7. Any further questions? … Lots !
8. The 'good advice' … was it followed?

**WHAT CAN ONE LEARN FROM THIS?**

1. This event did not rate as an incident (occurrence) and was not reported or investigated. Nowadays it would probably be shown up by Flight Data Monitoring (FDM).
2. Obviously the weather differed from forecast. Being an early morning departure, the weather documentation at flight preparation was based on an earlier meteorological situation. The upper flight level winds were wrong, the Pisa weather was wrong and, above all, the Rome weather was wrong. There was no specific indication that the Rome weather had deteriorated so much, until the ATIS was received. The location of the weather line did not show up until the aircraft was en route between TAQ and CMP. It is doubtful if any updates of the Rome weather would have been available in Manchester. The Volmet reports did show something was happening, but not enough to alert the crew. (Nowadays, weather reports requested on ACARS should provide more timely information). Even so, the indications seem to be that the squall line and rain passed over Fiumicino quite quickly. The ATIS had given rain and 30 kts crosswind, but still gave runway 16 as the 'runway in use'. In the meantime, ATC had already switched to runway 25 and by the time the Manchester flight had landed, the wind speed had decreased to W or SW at just 10kts or so.
3. This was very much a case of the crew, specifically the captain, being sucked into an adverse and deteriorating situation. It may not always be weather, but such situations can just as easily develop today as over 30 years ago.
4. The co-pilot was inexperienced, but there will always be inexperienced crew members. He did all that was required of him in a combination of circumstances and high workload (and perhaps stress – spooked by St Elmo like sailors in the past!) that he had not experienced before. Because of the radio navigation configuration, he had to fly the approach. This may have been fortuitous, as it was better that the captain should monitor him than the other way round. With a modern avionics fit and FMS, the situation could have been different. But the general case holds true: that the monitoring capabilities of pilots may be limited by their inexperience, so that who should fly and who should monitor may become a significant issue
5. The Ekco X-band radar was an excellent piece of its equipment for its time. The Captain had had experience of C-band radar on the 707, but was less confident in the operation of it, either on the 707, or subsequently on the 737. Though the latest aircraft radars are now more developed, with sophisticated features on later types, the lesson has to be: *know the equipment and how to operate it, to get all the information it can provide.*
6. In early jet operations, descent and approach planning (or energy management as it might now be called) were at a premium. Often procedural, ATC would clear aircraft for the approach and leave the approach plan and shedding of excess height to the discretion of the pilots. On the 707 the speed brakes were unusable in flight, while on the 1-11 they were ineffective. Control of drag at lower speeds was achievable only by using flaps and gear, unlike later jets, which could utilise powerful speed brakes at all speeds and in combination with flaps and gear at lower speeds. On the 1-11 the initial stages of flap gave more lift than drag, so a further reduction of speed to lower the gear and allow more flap, which would increase the descent gradient. Obviously, gear and full flaps with flight idle thrust was the ultimate drag configuration and could be used to shed excess height, with the proviso that the final approach had to be 'stabilised'. This was never done close to the ground. It was this steep nose down pitch angle that the co-pilot initially was not inclined to fly. One that was unlikely to have been practised in the simulator and therefore an unusual attitude for him. In other circumstances the captain might have flown the approach.
7. The aircraft had been vectored to intercept the localiser at too high an altitude. If it had been a full ILS, the aircraft would have been above the glide slope and the captain might certainly attempt to intercept the G/S from above – not the recommended standard operating procedure. Operating within the capabilities of the a/c, he would make

an assessment if this was possible. If not, the options were to ask to be repositioned by radar for another approach, or considering the circumstances on this particular flight, ask for immediate diversion to Pisa while he still had the capability. For this flight, any decision other than a Pisa diversion would have meant committing to Rome Ciampino as an alternate, or indeed, actual diversion to Ciampino. Irrespective of the decision making on this flight, one of the lessons is to have a full understanding of both the capabilities of your aircraft, its operating equipment and the confidence of the pilot to deliver these capabilities.

8. Decision making: of course, everyone will say in hindsight “you should have taken more fuel”. But when is enough, enough?
9. During the flight when the ATIS was first received giving rain, a wet r/w and a crosswind near the limit, was that time to divert back to Pisa?
10. When the landing r/w was changed to a non-precision localiser approach to r/w 25, with a cloud base close to minima and given that the captain, although familiar with Fiumicino, had never flown an approach to r/w 25; was that the moment to decide to divert to Pisa?
11. When faced with the continuous line of echoes on the weather radar en route between TAQ and CMP, although it did not show any contours, was this the time to decide to go back to Pisa? In fact although this weather line had it own surprise, there was little turbulence and no lightning, but plenty of rain; as it was criss-crossed four times.
12. When ‘Ethiopian’ got in the way and the ineptitude of Fiume Approach radar messed the flight around with extra manoeuvring, was this the time to decide to divert to Pisa?
13. And what about Ciampino ? Well, with the rainstorm line more or less overhead, it had been mentally ruled out as an option. The latest weather actual for Ciampino was not obtained. That was a mistake!
14. After my command check, I was given the following good advice: When you’re in command, remember that you can always put your co-pilot under pressure, slow down [*your demands*] so that he can keep up with you.

---

**SITREP 25 – In the Air**

**HUMAN FACTORS IN FLIGHT DECK MANAGEMENT**

**A possible drug smuggler?**

In this incident, the crew of a Long-haul B747 became aware of the possibility for a drug smuggling event to occur and had to advise the destination authorities, for them to take things further.

The subject flight was a non-stop Caracas to Gatwick overnight trip and the routine brief to all the crews on that route was to be aware of potential drug smuggling activities and to report them.

One of the flight crew members went to the upper deck crew toilet and became immediately aware of a strong smell of kerosene in the vicinity of the upper deck, left hand side emergency escape exit door. Given that it was an overnight flight, the whole of the upper deck was in darkness and so he took his torch from his briefcase on the flight deck to try and determine the cause of this unusual aroma. There was no doubt whatsoever in the crew member’s mind, that the smell had not been there when he checked that the door was secure prior to take-off, as a routine within his pre-flight checks. Thus it had to have been introduced by somebody boarding the aircraft.

Mindful of some of the extreme sports that people get up to, he wondered if this was a leaking fuel tank from some kind of internal combustion engine, badly packed and now leaking in some hand baggage. The hand baggage in question was dumped in the doorway recess and would not have been there during the Take-Off and could not remain there during the Landing either. He went back on to the flight deck to report the fumes and the Captain immediately requested a location and source report.

So the crew member took the step of opening a zipped up hold-all a few inches and the smell of kerosene became over-powering. Shining his torch within the bag, he saw an object that could only be described as a large ‘grotesque goblin’, with a very pronounced long nose and over large staring eyes. It appeared to be made of some kind of plaster-of–Paris or white resin, but dyed light brown and it was this object that smelt strongly of kerosene.

Going back to the flight deck after his natural break, he asked the Captain what he thought they ought to do about this situation. It was clearly not a serious fire risk, as there was no sign of liquid kerosene and the vapour would have dissipated in seconds, had there been any combustion source.

The Captain thought for a few moments and asked the Co-pilot for his thoughts too, which joint discussion revealed that masking drugs packaging by using strong smelling substances, such as coffee beans or kerosene, had been the topic of a recent drugs bust reported in the media. Jointly, the crew decided that the best people to determine the truth in this would be HM Customs & Excise on arrival. But a cunning plan would be needed, so as not to alert the ‘mule’ that they were under scrutiny. It would be essential to determine who the owner of the bag was.

To determine this, the crew member who had made the initial discovery went into the cabin during the breakfast meal service and held up the offending bag, now re-fastened. He asked who the bag belonged to and that it would not be permitted in the doorway during the landing and subsequent ground manoeuvres. The owner immediately claimed their bag and apologised for blocking the doorway. Mentally noting the passenger seat assignment, the crew member went back to the flight deck.

Using the aircraft library, the crew accessed Flight Crew Orders and Notices (or FCOs) and found a reference in one of the chapters about how to deal with smuggling. The crew made contact with the company head office by short-wave SSB radio and quoted the page number of FCOs that they wished to refer to. The radio operator at base immediately grasped the potential significance and initiated the necessary contacts with Customs. No mention had been made of the departure airfield or topic of information exchanged, lest this be of benefit to anybody listening in to the frequency used by the company – a common event by the media and others.

The flight crew briefed the Senior Cabin crew member (SCCM) that there would be 'something wrong with the Door 1 Left', the one routinely used during passenger disembarkation. This would mean that the SCCM would call the flight deck for one of them to come down and 'rectify the fault' or at least have look at the automatic door opening mechanism to ensure that it would be safe to use. Customs staff would be by the door and they would take over the situation.

The aircraft duly arrived and the planned door sequence initiated, such that the first person out of the door was the flight crew member. He briefed the two plain clothes customs officers and described the bag and the owner, together with the seat number they had occupied. The subject passenger left the aircraft at that point and the flight crew member merely nodded and carried on talking. A 'tail' was initiated and when the passenger was out of sight, another team of specialist customs officers and 'sniffer dogs' came into the boarding finger via the maintenance steps and side door. A thorough search was made of the seat and the area where the bag had rested by the door, but no drugs could be detected. So the search was widened across the whole aircraft and traces of drugs found in a number of locations, hardly surprising given the departure airfield.

The aircraft was out of service for several hours while more thorough checks were made and neither the subject crew nor the company were notified of anything found untoward.

**WHAT CAN ONE LEARN FROM THIS?**

1. Drug smuggling is big business and subtle ruses to confuse and distract are common.
2. Know where to find out what your company policy on searching passenger's bags is. On this occasion the Captain requested that the crew member determine the source of the kerosene fumes.
3. Should the passenger have been present?
4. What procedures does your company have whereby crew messages of a discrete nature can be passed?
5. Given the changes, in Flight Deck Door and security protection routines since this event, what will your cabin crew need to know to be vigilant at all times and how will they let the Flight Crew know?

---

**SITREP 26 – Airborne operations**

**THE MANAGEMENT OF VERY COLD JET FUEL**

In this short essay, the experience of having to deal with Jet-A kerosene fuel when near the fuel freeze point is described and the human factors involved.

The event in question was on an intercontinental Seattle to Heathrow overnight flight, with the Trans-Atlantic section well beyond the Northern limit of the North Atlantic Tracks. This was to take advantage of favourable winds and placed the aircraft in Canadian airspace between Baffin Island and Western Greenland. The night-time display of the *Aurora Borealis* was spectacular and had the flight crew riveted to the forward windscreens; also inviting those members of the Cabin crew not on duty to view this display too. The aircraft was a Boeing 747 classic aircraft with a crew of Captain, Co-Pilot and Flight Engineer Officer.

The flight had been airborne for about 4 hours and the flight engineer had been paying close attention to the fuel temperature in No. 1 Reserve Fuel tank, one of a pair of very small fuel tanks, right out on the wingtips and thus the coldest part of the wings. Additionally, for wing loading reasons, these tanks are kept full until the last part of the flight. This tank is always empty on arrival at destination, as part of the routine operation of fuel system management and thus is always re-filled prior to departure with whatever fuel is supplied. In Seattle, as in the whole of 'the lower 49' states in the USA at that time, the fuel supplied was Jet A kerosene with a published fuel freeze point of -40ºC. Since there would have been an empty tank prior to refuelling, there would be no 'alleviation' to the fuel freeze point, from mixing with any fuel remaining, as enjoyed by the other main tanks.

The Standard Atmospheric Lapse Rate for temperature is accepted at -2ºC/1000 feet of climb, from the Standard day of +13ºC down to the Tropopause at -56ºC. Depending on the height of the Tropopause, this lower temperature 'limit' is neither finite nor predictable and it was with some alarm that the flight engineer observed that the Outside Air Temperature OAT gauge, on the Co-pilot's forward instrument panel, was indicating -70ºC! This caused the flight engineer to pay much closer attention to the No. 1 Reserve Fuel tank temperature and he noted that, after 4 hours of flight it was already indicating -30ºC and this triggered a memory of a page note in the Operations Manual. Flight at Mach numbers in the Trans-sonic range will deliver a Kinetic heating effect of approximately 20ºC and thus the likelihood of the fuel actually freezing in the tank under normal circumstances, very small indeed. The flight engineer could not recall to himself when he had last looked at the OAT gauge, part of his 'forward scan' but easily obscured by the body mass of the Co-pilot moving about his business.

The flight engineer extracted the manual from the stowage adjacent to his seat and looked up the reference to refresh his memory, where he read that when the fuel tank temperature falls to within 10ºC of the fuel freeze point, the Captain must be informed. Rather than break-up an interesting dialogue of the *Aurora* phenomenon between the Captain and one of the stewardesses, he merely handed the Captain the book, pointed to the bit of the page with the note and then pointed to the OAT gauge.

The Captain immediately broke off the conversation and handed the manual to the Co-pilot with the same gesture to the OAT gauge. In the brief time that this took, the flight engineer noted that the fuel tank temperature had fallen by another one or two degrees, it was difficult to be precise, as the gauge is very small and the divisions even smaller. The Captain then called for the flight planning meteorological charts to see if there was something he had missed during the pre-flight briefing. Nothing of any significance was to be found on these and it is important to remember that by the time you need the information, it is already several hours 'old'. SIGMETS are broadcast at regular times, as a part of weather broadcasts, but there is a need to be aware of these times and locations covered and listen to them; and this had not been done by anyone on this crew for some time.

The manual was quite specific about what to do if the fuel tank temperature continued to fall, such that if it declined to within 5ºC action was required, to wit, descend and also fly faster, so an immediate call was made to the ATC services provider at Churchill Falls. This call was also picked up by another aircraft in the same vicinity, who asked us where we were. The whole crew became involved in the situation, using both VHF sets and SSB shortwave to alert both other aircraft and ATC providers that the subject flight would need to descend and increase Mach number.

Meanwhile the OAT gauge did not move from -70ºC and the whole flight crew were getting quite alarmed. Was the OAT gauge reading reliable? The fact that the engine inlet fuel tank temperature was also declining did indeed confirm that it was indeed unusually cold and then one of the other aircraft called up to say that they had just flown into this cold air-mass too!

ATC called up to give us descent clearance and asked us to report when the OAT rose again and this latter point was echoed by several other aircraft. A laconic American accent radio call caught our attention.

"Yeh Speedbird. That cold air seems to end at around 59ºW and it comes down south as far at NAT (North Atlantic) track 'Victor'. Best of luck you guys." No call sign or other ID, but welcome nonetheless, although 59ºW was a good 10 minutes flying East, ahead.

Descending 4000 feet enabled the flight to reach a 'warmer' air-mass and speeding up to Mach 0.87 arrested the slow but insidious fall in the fuel tank temperature; that at one stage had indeed reached -35ºC. But it took the time almost to the end of the cruise phase of the flight, some three hours later over Tiree in the Outer Hebrides of Scotland, before the flight engineer could 'ignore' the fuel tank temperature gauge from his usual systems scan. By then it was time to use the 1500 kgs of fuel that was still in each of Nos. 1 & 4 Reserve Fuel tanks and when he opened the Reserve tank transfer valves, he was delighted to observe the tank contents declining and the associated main tank contents increasing, although this took longer to transfer than normal. Fortunately too, there had been no instability in fuel pressure, flowmeter rate, or engine indications, so the components dependent on the fuel flow through them did not seem to have been affected.

The rest of the flight continued as normal but some lessons had been learned. The Captain kept us back for a few minutes, when finally parked and reminded us of our specific monitoring tasks and routine activities, putting his hand up to the distraction and the social consequences of the stewardess being there when we needed to be most vigilant. This was not a 'You are to blame' sort of chat, but a 'de-brief after a close shave'.

**WHAT CAN ONE LEARN FROM THIS?**

1. The *Aurora Borealis* and Its Southern Hemisphere counterpart are an arresting sight and can provide a significant distraction, particularly during a boring phase of the cruise. Keep an 'eye on the ship' - at all times! Shouldn't the Co-Pilot have picked this up sooner?
2. Jet fuel comes in a variety of specifications and your manuals should tell you what to do when you get close to the freeze point. There is little time to ponder what to do, so do you know where to look and in which place, for the necessary guidance, if your memory lapses?
3. If this had occurred on the congested part of the NAT track system, or other 'crowded sky', such that there would be numerous other aircraft in the same predicament, how would you manage the 'descend and fly faster' action?
4. The volume of fuel that would have frozen on this aircraft type would have been a significant part (35%) of the Fuel Reserves. Had this indeed become unusable, what would be your next action?
5. Super cold fuel effects are not easy to simulate during the conversion flying details, so it will need to be examined by observation during route flying training. Make it your life-long task as a Captain to keep a 'scan' going, to include things like the OAT indication, especially in the latter stages of the cruise. It might not be on the 'top page' of the ECAM display.
6. When it seems that a part of the crew might have 'let the side down', how will you address this and when?
7. Low temperature is not the only thing that can cause fuel to become unusable. What other things can 'spoil your day' in this area? (There are several Incidents in the UK CAA database about fuel contamination.)
8. Was this a 'Reportable Incident' to the regulator and if so why?

9. It is rarely a single ‘person at fault’ and the trick is to ensure that any lessons that can be learned get passed on to the rest of the fleet and the whole of the Flight Operations department, indeed the airline industry, if appropriate.

---

**SITREP 27 – General**

**THINGS THAT GO *‘BANG’*, DAY OR NIGHT**

In this Incident on a Lockheed L1011-500 Tristar, the crew member doing the external check finds some minor tyre ‘wear’ that had an effect on what happened next. The -500 Tristar is supported on 8 of some of the largest main wheels in transport aircraft and any damage to these is closely assessed prior to flight. It is not at all uncommon to find small groups of cuts in the tread pattern, caused by the wheels ‘tramping’ during tight turns and literally being twisted against the ground surface. Destination was Bermuda, where the weather forecast was poor, with low cloud and rain and a significant cross wind.

The flight engineer discovered a few of these cuts on the very crown of one of the main wheels and, meeting the ground engineer at that point, skimmed his hands over the cuts and said ‘Hi’ as they passed.

Everything went according to plan until, during the Take-off roll, at about 5 kts below V1, there was a distinct ‘thump’ or ‘bang’ heard and felt through the floor and rudder pedals. With no other indications, the Take-off continued and the Landing Gear was selected up. All indications associated with this were normal and the flight was safely established and we were on our way. We had a brief discussion about the bang, but put this down to a Nose wheel striking a runway centre-line light, as the Captain recalled making some small inputs to the rudder late on in the Take-off roll.

Then, the flight deck door was opened and the Mid-section Purser appeared. “Was that a dog, a swan, or a stowaway falling out, that we hit just before we took off? Whatever it was it came through the floor under my feet!”

Turning around to face him, the Captain asked “If it came through the floor, why didn’t you bring it to us so that we could tell you what it was?”

“No! No! Captain, I don’t mean through the cabin floor, but through the outside”, the purser quipped. “But whatever it was, it was right under the floor by my crew seat”.

“Sh…t!” responded the Captain. “Cancel further climb and decrease cabin differential as quick as you can Eng. Then do a full systems check and pay close attention to the Brake Temps. I think we blew a tyre. Get back on to ATC and tell them that there may be tyre debris on the runway.”

The flight engineer’s systems check was wholly normal and he reported this to the two pilots, who were busy co-ordinating departure turns and ATC frequency changes

The Co-Pilot negotiated a quiet piece of sky while we evaluated the damage and the engineer went back to the mid section and, discretely placing his ear to the floor, could hear and feel the vibration of loose or distorted metal and so he hurried back to the flight deck. He reported what he had found and the Captain called a brief crew conference.

“I think we have had a Main wheel burst and we know from the Engineer’s assessment that the hull has been hit. The Flaps are retracted and we can’t see the Tail or Stabiliser section. Nothing is abnormal on the Brakes. Given the Bermuda weather, I propose we go back. Give me your thoughts, guys and we will have to dump fuel and may have to evacuate after landing, particularly if anything else breaks or falls off when we hit the ground at speed.”

The two other crew members agreed that, given the uncertainty about the damage, there was no point I pressing on and that keeping the differential pressure low, would minimise the risk of a de-compression adding to their worries.

“Call the company on box three, Eng and tell them we’re on our way back and that we have had Landing Gear and possible fuselage damage”, ordered the Captain.

Making contact with the company engineering office, the flight engineer had a laconic response to his initial call-sign contact.

“Hi xxxx … We wondered if we’d hear from you. You remember when we met doing the external check and you skimmed the number 4 Main wheel tyre and said ‘Hi’ to me? Well I have that very same piece of tyre tread in my hand and it is the size of a dinner plate! The rest of the tread is in several big pieces but there is no sign of the tyre carcase. No sign of any metal or components either. We think you got off lightly”.

“Thanks for that but we are on our way back as soon as we can get rid of the fuel somewhere” the flight engineer replied.

The rest of this short flight was pretty normal, though as a safety measure, the Cabin crew briefed the passengers that they might have to evacuate after the landing. The Emergency Services escorted the aircraft down the runway until the aircraft had come to a standstill. The Fire Chief came on to a headset and advised that there was no risk of fire, only minor damage and that we could be towed to a stand. The Captain made a quick public-address announcement to the passengers and cabin crew, to advise them that there would be a short wait until we would be towed to a stand and that they were to remain in their seats. Ground engineers and a tow crew came to the aircraft and deflated No. 4 Main wheel as a precaution.

On stand the flight engineer saw that the whole of the No. 4 main wheel tread had been torn off the carcase and that as the bits flew off, some of them had struck the wing-to-fuselage fairing, behind which is one of the hydraulic air driven pumps. Distorted and torn metal were evident and it was the force of this damage that had alarmed the purser.

Several weeks later, the Captain and flight engineer met up and the E/O asked the Captain if there had been any follow up to their incident, as he had heard nothing.

"As you ask, yes there was" replied the captain, with a jovial gleam in his eyes … "I was asked by the chief pilot to justify my judgement in not carrying-on to Bermuda and so I told him the story, much as we discussed it at the time. I pointed out the folly of attempting a long flight over the Atlantic with a damaged hull and the subsequent landing conditions we would have had to have faced, with significant wheel braking degradation and that hindsight is a wonderful thing. I've heard nothing since!"

**QUESTIONS**

1. What would you decide if you felt a bump through the soles of your feet during the Take-off roll close to V1?
2. Would it have been more prudent to stop? Remember that at high weight you have much more energy to manage!
3. Was it necessary to go to the noise 'proximity' area in the cabin to check? (Remember locked flight deck doors now). What could be achieved from this? If unnecessary, … why so?
4. Was the passenger briefing for a possible evacuation prudent? If not, why not?
5. Should the wheel have been changed before the flight? The flight engineer made a 'judgement call' based on several decades of experience of looking at tyres, so as a pilot, how will you deal with judgement calls like this?
6. How do you decide in your mind, as a Captain, what weight you will need to have dumped down to, to give you some margin for error?

**WHAT CAN ONE LEARN FROM THIS?**

1. Aircraft wheel/tyre failure is a 'pretty uncommon thing', but with immense levels of energy within a tyre at Take-off speeds (remember - crudely - that the energy is proportional to $mV^2$). Flying tyre debris can easily penetrate aircraft skin-gauge alloy panels and the damage to composites can be even more destructive and, significantly, less easily detected by the human eye.
2. Be very wary of placing full cabin differential pressure into a damaged fuselage.
3. Always Review your destination airfield and Alternate if you have any Landing Gear damage.

---

**SITREP 28 — On the ground**

**FIRST TRIP AS A CAPTAIN**

In this example, a U/T Captain has completed the 3 month Type Conversion course, successfully passed his final 4 sectors of Line Check operations and, while still overseas, is offered an additional 2 sector day trip by 'promotion in the field'. The aircraft is a B747-236 Classic, with crew of a Captain, First Officer and a Flight Engineer. Hitherto on the trip, a Base Training Captain, U/T Captain in the left-hand seat and the flight engineer, with the Co-Pilot rostered for the trip for some reason but 'dead-heading' and flying as an observer, had operated the flights.

The Base Training Captain had called the Co-Pilot and the Flight Engineer to his room in Delhi and asked them for their opinions about a novel plan. He proposed to offer the U/T Captain his first sectors in Command while in the field, but only if the two crew members were happy to agree to this. They both immediately agreed, based on several debated points.

The U/T Captain knew us all well by now, having been in our company for over a week, flying every other day. His operation had been 'textbook' and his CRM had not been unduly biased. The flights were structured using the 'monitored approach' philosophy. In these, the Co-Pilot would do the 'let-down', from 10 minutes prior to Top-of-Descent, carry out the Approach and only hand over to the Captain to land the aircraft at Decision Height. The Indian sub-continental weather was not unduly critical and the 'shuttle flight' to Calcutta and return to Delhi would be made during daylight hours.

The Training Captain telephoned company HQ and the Chief Pilot agreed with the plan, organising the changes to Insurance and Duty Codes and, above all, the U/T Captain's pay! Following the planned sectors, the U/T Captain would stay on the aircraft and fly as a passenger, all the way back to London to complete any further formalities and changes to uniform etc. For the trip on the day, the Training Captain lent the U/T captain his hat and epaulettes. The jacket was not required, in the circumstances.

All went according to plan, with much banter and wit on the crew bus and lots of positive support from the station staff during pre-flight briefing and ground activities. The aircraft arrived on schedule from the overnight flight from London and there were only minor cabin defects to address in the Technical Log. No significant Deferred Defects either and with the flight plan fuel correctly loaded and the load sheet presented for signature, the new Captain felt that his day was going 'on rails'. The Co-Pilot requested start clearance and the Flight Engineer set the aircraft systems in the Engine Start configuration.

Delhi is classified as a ‘hot and high’ airfield and this has consequences in the starting technique for the Rolls-Royce RB211-524D4 engines. If the relationship between the 3 independently rotating spools within that engine is not within precise limits, the engine will not start correctly, but go into a ‘Hung’ or ‘Hot Start’ with a risk of a Tail Pipe Fire. This limitation is thoroughly explored during the simulator conversion details and drills provided, to mitigate against the total loss of an engine, or worse. The middle of the 3 spools, known as the IP or N2 spool, is ‘controlled’ by variable inlet guide vanes and they sometimes drift ‘off schedule’, especially if, during the previous cycle, they have not been allowed to ‘stabilise’ after Reverse Thrust selection.

The Start sequence for the engine requires that it is ‘motored’ by a pneumatic driven starter motor until it will not accelerate any more, upon which, the Flight Engineer calls “Max Motoring”. To achieve this, the Flight Engineer operates a spring-loaded switch in the flight deck roof panel and checks, by several indications that the Start Valve has opened and that a pressure drop tells him that air is actually going to the motor. This part of the start is time critical and the Co-Pilot has a stopwatch checking that the overall time limit of 3 minutes for the starter motor is not exceeded; otherwise it can be seriously damaged. The crew are required to check that all three spools are turning and the ground staff will call “N1 Rotation” as this is something that they can readily observe and at this low RPM, little if anything will show on the appropriate indicator.

On the ‘Max Motoring’ call, the Captain raises the Start Lever from the gated ‘Cut-Off’ position to ‘Run’ and starts a stop watch of his own. This to check that the engine fuel ignites and the engine begins to accelerate. If ‘Light Off’ does not occur within 10 seconds, the Start Lever must be placed back to ‘Cut –Off’ and the engine motored for a further 30 seconds, called a ‘Dry Cycle’, to ‘purge’ the fuel already introduced.

The worst-case scenario is that a Hung Start takes place. This is when the engine starts to light up but, for internal gas flow instability reasons, does not build up to ground idle self-sustaining speed. Hot and High airfields are more prone to this dilemma. Hung Starts can rapidly degenerate into Tail Pipe fires. Too much fuel is flowing into the engine for the airflow to manage and sheets of flame can come out of the tail pipe.

The new Captain confirmed that he was ready to start No4 Engine, the first in the start sequence for this type of aircraft and the flight engineer responded with “Starting 4”, simultaneously opening the No4 Start/Ignition switch whilst the Co-Pilot hit his stopwatch start button. The inner spool of the engine began to turn and, after about 20 seconds, the N3 spool speed reached 22% and the engineer called “Max Motoring 4”. The Ground Engineer confirmed “N1 Rotation”, too. On this call, the Captain then responded with “Fuel in 4”, placing the No4 Start lever to the ‘Run’ position and started his stop watch too. All eyes were on the EGT gauge, with the flight engineer closely watching the engine RPMs, to check that all three spools were accelerating.

“Ground to Flight deck … there is a lot of white smoke and fuel coming out of the back of the engine, Captain”

“EGT rising pretty slowly, Captain. I think we have a Hung start,” said the flight engineer.

“I think we should give it some more time as the EGT hasn’t reached 600°, responded the Captain. (600°C is a Starting temperature limitation on this engine)

“Kill the Fuel,” advised the flight engineer. “I only have 35% N3 and it has ‘hung’. It doesn’t sound right either”. (Curiously, the RB211-524 makes a characteristic sound if it ‘hangs up’, but this cannot be replicated in the simulators).

“Tail Pipe flames” … from the ground engineer.

“Start Valve Closed” said the flight engineer, as he let go the spring-loaded switch, following the drill required to achieve this. This was essential to protect the starter motor drive gear train from being shattered, by the decelerating engine back driving the gearbox.

“Captain you must switch the fuel off!” called the co-pilot and flight engineer together.

Reluctantly, it seemed, the Captain finally did this and as the ‘hung engine’, now starved of fuel, began to decelerate, the flight engineer once again checked the N3 gauge and when this had reduced to 25%, re-opened the Start valve to ‘crash re-engage’ the starter motor, to blow the fuel vapour away.

“30 Seconds. Max Motoring No4” called the flight engineer. The Captain re-introduced the fuel and the subsequent start was normal.

When the engine had stabilised, there was an audible sigh of relief from the Co-Pilot and the flight engineer. What had gone wrong? The new Captain had already handled a dozen engine starts in Delhi that week and demonstrated numerous hot starts in the simulator? Was it nerves? It took a few seconds but the spell was finally broken by the ground engineer, who called: ”Standing-by to start No1 engine Captain”. This was all the crew needed to snap back to business and the rest of the day was uneventful.

When they got back to Delhi, the new Captain was off to change into casual clothes to passenger home, but the flight engineer held him back on the flight deck to give him some friendly advice.

“Please don’t ever query the start sequence again, on this fleet, Captain. It has been worked-out by better people than you and me and, believe me, it works. We were very lucky today not to have had a major Incident”.

The Captain began to fluster and flounder about who did what or when and the flight engineer intervened again. “No sir! There are no ‘other ways’ or opinions about this. The drill is the drill and we didn’t get it right today. Best of luck in the future, sir”

**QUESTIONS**

1. Was the Training Captain right to authorise this promotion-in-the-field? If not, why not?
2. What are the essential legal points that need to be covered to permit this?
3. Could this have been ‘First flight nerves”? If so, how will you guard against this?
4. How would you have responded to the call “Kill the fuel”?
5. Do you know all your engine limitations, throughout the operating envelope?
6. Modern jet engines have the start sequence managed by a computer. Do you know how to recognise a Hung Start or a Tail Pipe Fire?
7. The new Captain had ‘fixed his mind’ on the 600°C EGT limitation and ignored all the other cues being provided by his crew and the ground engineer. Was this a ‘trap’ not picked up in Training?
8. Was the flight engineer right to first offer advice and then admonish the Captain as he did? If not, why not?
9. Could/should the Co-Pilot have over-ridden the Captain on the Start lever action and cancelled the start sequence earlier? If so, how?

**WHAT CAN WE LEARN FROM THIS?**

1. You will almost certainly not have the benefit of a Flight Engineer to help you in the future, when things like this go wrong, so you need to ensure that you know your drills and recognise abnormal events. Your Type Conversion technical content will be minimal and concentrate on what you need to do to manage systems, rather than how they work.
2. Things can go wrong in the most unlikely ways and you must draw on every source of advice and information. Prudent airmen never stop learning about their aircraft.
3. The flight engineer raised the point that the ‘engine didn’t sound right’, based on his long experience of starting this type of engine all over the world. Listen to the sounds that your aircraft makes in every ‘normal situation’ and then you will recognise another ‘sense’, telling you something might be abnormal. This is particularly true for pneumatic systems, as the normal ‘whistles and creaks’, that will be heard throughout the flight, are ‘telling you’ something.
4. The role of the ground staff is somewhat ‘blurred’, in that they call what they see, but cannot do anything about it. But they know their airfield and what ‘normal’ looks and sounds like; so do not dismiss them until you feel happy to do so. This is particularly important during ‘push-back’ routines, as they can see all around the outside, whilst you cannot. Had there been an actual Tail Pipe Fire, they would have used their fire extinguisher(s) to put it out, but only possible if there was no more fuel feeding it. There is at least one recorded Incident of a flight crew, in a Tail Pipe Fire situation, forgetting all they had been trained to do and doing the Engine Fire Drill instead! This caused considerable damage to the engine and the wing above, followed by an Evacuation of the passengers!

---

**SITREP 29 – General**

**IT IS MORE THAN FLYING THE AEROPLANE**

The final First Officer trip is over. The addition of a fourth stripe and new hat will show the world a new Captain is born. All that was required was getting through the training. Right? Maybe there is more to it.

Following the weeks of ground school, simulator and initial operating experience, the first trip as a true Captain arrives. There is no question of technical qualification and no question of proper experience in the aircraft type. Finally, all the years of effort are resulting in that memorable first Captain’s trip. Everything is set. Right … Maybe there is more to it.

The pre-flight briefing is routine but the fuel requirements are pushed to the limit, because there is a full load and landing weight is limiting. How much fuel do you need, Captain? Well, the legal minimum is the answer. Right? … Maybe …?

What is the weather at the destination and the alternate? Crosswind? Unserviceable navigation aids? En-route winds? Known holding? Maybe a call to Dispatch or Flight Planning is in order. The weather is down; however, it is above minimums and forecast to stay that way, but there is a gusty crosswind. It is forcing a single runway operation and traffic is backed-up. Holding is likely but not occurring at this time. Category II operations are unavailable due to inoperative ground equipment. Captain, how much fuel do you need? Every kilogram of fuel, costs paying freight and passengers.

An example for this occurred in Zurich, where the crew had refuelled for a flight plan to fly direct to Bahrain, but right on the limited performance for the take-off runway conditions, only to be given a Load sheet showing a LMC +6,000kgs! The dispatcher pleaded with the captain to take the load, saying that it was ‘commercially vital’ and to ‘lose 6 tonnes of fuel’. Quite how he thought we could do that did not cross his mind. Or that this would have meant an en-route stop in Athens. To his credit, the captain declined and on return to base was faced by a furious chief pilot. The commercially vital load had been clothing for his wife’s boutique in Colombo!

In another, a ‘sixth sense’ by the captain prevented an almost certain accident had an engine failed on take-off on a BAC1-11 in Lima. Having signed the load sheet, he inexplicably felt the need to have ‘another look around the outside’. Whilst doing this out-of-the-ordinary second walk-around, he noticed that the nose wheel tyres appeared to be flat, when they had not been so during the walk-around check. Calling the dispatcher back, he insisted on the baggage and freight being re-weighed. From this he discovered more than 3 tonnes of un-manifested newspapers ‘left over from yesterday’.

So this question is more complex than it first appeared. Up until now our new Captain could depend on the judgment of a seasoned and hopefully, wise Captain to make such a decision. Now that your brand new fourth stripe is responsible … “What are you going to do, Captain?”

The shift in the mental pre-flight preparation as a new Captain is significant. The formation of a functional crew from a group of individuals depends on the Captain. Justification for changes in pre-flight planning depends on the Captain. The availability of the assets necessary to have the flight to go smoothly depends on the Captain. Our new Captain is in the centre of decisions affecting the flight.

Have we properly trained this new Captain? Have we properly checked not only his/her technical proficiency but judgment and decision making skills? Is he/she experienced in the demands of the “real world?”

As we adjust flight crew training to minimize cost, it is necessary that quality is not sacrificed. The objective requirements of the regulator, such as $V_1$ engine failure, certainly are demonstrated to satisfaction. However, the likelihood of a new Captain facing the uncertain situation requiring judgment is much more likely than an engine failure at $V_1$.

A number of recent accidents show that the Captain made decisions resulting in catastrophic consequences. Is this the actions of a rogue individual, or a failure in training and checking? If it is the actions of rogue, why was this tendency not discovered prior to upgrading to Captain?

If it is the actions of a rogue, why are there so many rogues?

While the accident rate is very low, preparing new Captains to meet the challenges of the “real world” by proper training and checking is essential to continuing this trend. Let us take a close review of the recent accidents and serious incidents, learn the lessons and adjust the training programs accordingly.

The position of Captain is more than just flying the airplane…definitely.

**COMMENT**

1. Think about your new job.
2. Do not be frightened to seek advice from others. You will find that they are more than willing to help and will respect you for it.
3. Above all enjoy the new responsibility.
4. Remain professional at all times.

---

**SITREP 30 – STAY OBSERVANT ALL THE TIME**

**What is missing …?**

South African CAA Accident report - B737-200 ZS-OEZ - 8 November 2007 - Cape Town

**Be prepared for the unexpected … always.**

**Engine lost after V1 during take-off … literally. The engine was found near the runway on the airport.**

***SO YOU WANT TO BE A CAPTAIN ?***

**VIGILANCE AT ALL TIMES ... Leave NOTHING to chance**

**To conclude …**

RAeS publications **photo**

**Jump in … the water looks great !**

Boeing-787 'Dreamliner' Boeing photo

… and do enjoy your new 'Office' -

**END OF PART 4 - SITREPS**

## INDEX OF APPENDICES

## APPENDIX A – PRACTICAL APPLICATIONS

**USEFUL TIPS AND SHORTCUTS**
Compiled by Captain Ralph Kohn FRAeS
With contributions as shown

This Appendix contains tips, and shortcuts to facilitate some of the operational situations encountered in day-to-day flight activities, whether on the ground during pre-flight preparations or later in the air.

### 1. FIRE WARNING

With thanks to Captain Paul Wilson FRAeS

After completing the appropriate fire drill following a fire warning, carry out a fire warning system test, to confirm that the fire is indeed out. This is essential, to check that the warning has stopped indicating because the fire is out and not because the fire detectors have been destroyed by the fire; which may therefore still be burning.

### 2. PASSENGERS' LUGGAGE RECONCILIATION CHECKS

In the event of a need to reconcile passengers on board with their hold-loaded luggage, when a passenger fails to board, the following procedure will minimise delay. Always keep the Security aspect in your mind.

Arrange for steps to be placed at the furthermost rear door of the aircraft and at the first door at the front of the cabin. Have all the luggage removed from the hold and lined-up on the tarmac in rows, to allow passengers freedom to walk past the off-loaded bags whilst looking for their suitcases and other belongings, to establish ownership.

Get the rearmost-seated passengers to leave the aircraft from the rear exit and have them identify their belongings, which can then be set to one side by ground staff. Once their effects are identified, the passenger re-boards the aircraft from the front, following the queue back to his / her seat and 'presto!' the task is done, with the least amount of fuss and disruption and in the minimum of time. If necessary, this task could be delegated to the aircraft handling agent co-ordinating the departure, under your supervision.

### 3. CONTINUOUS DESCENTS TO ACHIEVE A 3º PATH FROM CRUISING HEIGHT

**Rate of descent target** (**throttles to idle**) = ½ Ground Speed x 10 (in feet per minute)
Or … 5 x Groundspeed

**Time or Distance from a radio facility**

Time in seconds between bearings, divided by degrees of bearing change = minutes from station

e.g., $\frac{\text{120 seconds}}{10^{\circ}}$ =12 minutes from station

TAS or Ground Speed in nautical miles per minute x minutes from station = distance from station

e.g., $\frac{\text{360 knots}}{60}$ x 12 = 72 n.miles from station

### 4. TIME TO GO TO FACILITY CALCULATION (E.g. for speed reduction)

TAS in Nautical Miles per minute approximately equals the Indicated Mach number. For example, a Mach No. of 0.60 is roughly 6 miles per minute. So if the aircraft is 72 miles away from a VOR / DME station, the time to reach it is 12 minutes (72 ÷ 6 = 12).

It is an easy way of establishing time to any VOR/DME in flight if need be, e.g. to check progress. It is also a rough 'spot reading' that gives an approximate idea of how much time is left before having to start reducing IAS to the target hold-entry airspeed when approaching a holding fix, to satisfy the requirement.

Requirement: When approaching a 'holding pattern', an aircraft needs to be at the appropriate aircraft category-specific speed for the Flight Level at the point of holding-pattern entry. This should be achieved by a speed reduction commencing at least 3 minutes prior to reaching the holding point, to start the entry procedure (as per Rules for Holding patterns - see Part 3, Section 22).

Translated into distance, 3 Minutes at a Mach No of 0.6 (Time x Mach No = Distance) is simply 3 minutes x 6 = 18 n. miles DME from the VOR Station.

### 5. SHORT-CUTS TO USEFUL FIGURES

**5.1 Aquaplaning speed** (**in knots**) = 8.6 x √ tyre pressure (in PSI) – (See Winter Operations, Appendix C - Item 13)

To avoid hydroplaning-induced far-end runway over-runs and tyre damage from rubber reversion, if there is any doubt as to the probable extent of water of depth greater than 3mm on the landing runway, an alternative runway should be chosen. If the flight crew become aware, just before landing, that the depth of water on the runway has increased to such an extent (3mm or more), especially in the touchdown zone, then a go-around should be flown. If this circumstance is not apparent until touchdown, then, provided it is permitted by the AFM, the landing should be promptly rejected from the runway. If unable, ensure spoiler is fully extended as you brake and use full reverse to a stop. Remember that braking effect is reduced to below 20% of normal, in wet and slush slippery conditions.

### 5.2 Radius of turn in Nautical Miles

Rate ½ turn: 1 % of speed in Knots
Rate 1 turn: ½% of speed in Knots

### 5.3 To calculate required bank angle for a Rate 1 Turn

**Knots:** Remove the zero from the true airspeed + 7 = required bank
e.g., IAS 90 knots: 9 + 7 = 16$^{o}$ bank

**MPH:** Remove the zero from the true airspeed + 5 = required bank
e.g., IAS 90 mph: 9 + 5 = 14$^{o}$ bank

### 5.4 Fuel Dumping Time

With thanks to SEO Peter G Richards I Eng, FRAeS (BA Ret)

RULE OF THUMB**:** As a rough guide, aircraft dump fuel at a rate of 2% of the AUW (All Up Weight) per minute. This equates to approximately 1 to 2 tonnes per minute.

1. A B747 could need to dump fuel for as much as 1 hour.

2. Work out how long it will take to dump the fuel and then work backwards from, say 10 minutes from where you expect to do the landing check, to complete the fuel dump, i.e. you are now committed. In other words, work out a "Tactical Fuel Dump Point." **Conserve your fuel.**

3. Fuel is **"The Life Blood of an Aircraft,"** do not get rid of it until you absolutely have to. Other problems may arise in the interim, which may change the plan (think "GRADE") … you might need the fuel.

4. Note that you don't always want to land at maximum landing weight, especially if you suspect, or have had confirmed, damage to Landing Gear, Wheel Brakes or Tyres.

### 5.5 Weight of AVTUR / Kerosene (for Gross error checks)

a. US Gallons x 3.044 = weight of Kerosene in Kilos
b. Litres x Specific Gravity (SG) = weight of Kerosene in Kilos
c. Imperial Gallons x SG = weight of Kerosene in Pounds (Lbs)

### 5.6 To convert temperature in Centigrade (Celsius) to Fahrenheit

| | |
|---|---|
| Take the reading | say-40 $^{o}$ C |
| Double it | -80 $^{o}$ C |
| Subtract 10% | - 8 = - 72 |
| Add 32 | +32 = - **40 $^{o}$ F** |

### 5.7 Actual Outside Air Temperature (OAT) / Static Air Temperature SAT (SAT)

| | | |
|---|---|---|
| a. | Take the first two digits of the True Air Speed (TAS): Say 464 kts … | **46** |
| b. | Subtract 20 … | 46-20 = 26 |
| c. | Add RAM AIR Static Temperature (TAT) say 14ºC: | 26+14 = 40 |
| d. | Result = Actual Static Outside Air Temperature (OAT): | **OAT = - 40** |

**OR**

**SAT (Above FL 260):** (With thanks to Capt Nils Bartling MRAeS - Hapag Lloyd)

a. Subtract 50 from the Mach number (.76 – 50) = 26 (treat as a negative number)
b. Then subtract this number (26) from the TAT instant reading (say -25ºC).
Hence: (sum) -25 -26 = **SAT approx - 51ºC**

### 5.8 Barometric Pressure correction

a. Inches to Millibars x 33.86
b. Millibars to Inches x 00295

Or approximately 3.5 Millibars for each 0.01 inch departure from Standard (29.92")

Example : to obtain the Millibar equivalent of a pressure reading given in Inches

i. Say the pressure is 29.81", subtract this from 29.92 (29.92 - 29.81 = 11)
ii. 11 x 3.5 = 3.85 (approximately 3.9 rounded up/down to the nearest whole number

iii. Taking Standard atmosphere pressure to be 1013.2 Mbs

iv. 1013.2 – 3.9 = **1009.3 (1009 rounded down to the nearest whole number)**

v. **For an actual reading of 29.81" set 1009 Mbs**

**5.9 Height difference between actual Density Altitude and Pressure Altitude**

a. Multiply Temperature deviation from ISA by 120
b. ISA +/ - actual temperature at cruising height x 120 = Height Difference
c. Subtract /Add to the Indicated Altitude to obtain the True Density Altitude

**5.10 Immediate re-land after take-off**

Perhaps for the line pilot, one of the things to know is the approximate relationship between V2 and Vref. If you have just taken off and have to return immediately without having time to look things up, your V2 speed can be bugged as the Vref speed, for a full flap landing. It is a few knots higher, about 5 – 7, than the correct Vref for the weight of the aircraft at that time. Consider this to be a built-in safety factor.

**5.11 Flying a circuit on generic speeds**
With thanks to Captain Phil Hogge FRAeS (BA Ret)

Put out half the flap, line up and open the power to a little short of full power. Accelerate to 150 knots and rotate to 12 degrees. When airborne raise the nose to 15 degrees, raise the gear and climb out at 180 knots. Turn through 180 degrees plus or minus twice the drift and continue climbing to 1,500 feet. Fly past the end of runway, start the stopwatch and run for 60 seconds. At 60 seconds put out another increment of flap (depending on how many flap settings the aircraft has) and turn onto finals. When on finals descend as necessary and slow to 160 knots. Put the gear down at 1,200 feet, followed by full flap, and then slow to no less than 150 knots. At around 500 feet bleed the speed to around 140 knots and put it on the ground. It may not have conformed to the exact procedure for that particular aircraft type, but it worked all the time without infringing any limitations & seemed to be OK.

*Thus on the type for which one is trained and flying, it is not too difficult to have a simple rule of thumb in the back of one's mind if all else fails.*

Obviously, what is described above only works at normal circuit weights, but it is not too difficult to add speeds for the higher weights on a type with which one is familiar. But perhaps one needs to be a bit careful recommending such crimes to new commanders; it all depends on how much common sense is applied!

**5.12 Cross-wind component (CWC) & Wind Correction Angle (WCA)**
With thanks to Captain Nils Bartling MRAeS (Hapag Lloyd)

**i. CWC** = speed of wind * sin (angle of wind)

| **Angle** | 10° | 20° | 30° | 40° | 50° | 60° | 70° | 80° | 90° |
|---|---|---|---|---|---|---|---|---|---|
| **Sin(ά)** | 0.2 | 0.3 | 0.5 | 0.6 | 0.7 | 0.9 | 0.9 | 1 | 1 |

E.g., a 30 knot wind 20º from the runway heading gives a cross wind component of 30 x 0.3 = 10 kts. [A little less precise: Sin (ά) = alpha/100 + 0.2]

**ii. WCA =** CWC / F where F = TAS/60

*Apply the result as a heading correction into wind to maintain desired Track*

The FMC can provide this information, though it is instantaneous and may not be representative of the conditions on the runway, which are necessary to determine if it is outside the operating limit.

**6. ENGINE FAILURE AFTER V1 DURING TAKE-OFF** (Keep it if you already have it)
With thanks to Capt R K J Hadlow, SEO P. Richards & Capt P H S Smith for their inputs

Should you experience an engine failure during take off well after V1 and have already accelerated to a speed beyond V2 and/or V2+10 or more, maintain the speed you have achieved, to eventually clean-up the aircraft as you accelerate to a 'clean' climb speed. If you are comfortably climbing at V2+10 or even maybe V2+15 if light, do not be tempted to reduce the airspeed towards V2, as you do not know what collateral damage may have been caused by the engine failure. This may have affected lift devices on the wing, which is 'Flying' comfortably at the airspeed that has been achieved. The faster you fly, the better the 'Rate' of climb anyway. Details that follow are taken from the accident report, to illustrate the point.

*A DC10 crashed after it experienced a No.1 engine strut failure and subsequent engine separation on take-off from Chicago O'Hare Airport, on May 25, 1979. Unbeknown to the pilots, the engine passed over the wing. This caused damage and resulted in the leading edge flaps retracting, with also the loss of the stall warning and slat disagreement indication systems. There would have been no indication to the flight crew of the slat retraction and its subsequent performance penalty. The first officer continued to comply with carrier procedures and maintained the commanded pitch attitude that had been programmed by the company into the Flight Director system (the flight director command bars dictated pitch attitudes that decelerated the aircraft toward V2). At V2+6 (159 KIAS), the wing dropped and as this speed* *was less than the stalling speed for the damaged wing, the aircraft started a roll to left. It crashed into the ground inverted, killing all on board.*

*The reduction to V2 was as per company SOP following an engine failure after V1 and beyond Vr, as taught during training and consequently programmed into the Flight Directors on the fleet.*

A design fault allowed the leading edge flaps to retract, but they could have been severely damaged by the engine as it separated, causing a similar effect. This could happen to any aircraft.

Following an engine failure at take-off, target airspeed during the initial climb should be a minimum of V2 to obtain the climb gradient necessary to achieve the required performance profile for obstacle avoidance close to the runway. When control has been established in the initial climb and the failure has been positively identified the throttle of the good engine may be advanced if it is below the maximum power permitted by SOPs, staying straight with additional rudder input, after which the engine failure drill should be commenced. Limitations of temperature and RPM must be observed and there may be a time limit for the use of this power setting after which, power should be reduced to Maximum Continuous Power. What is important is that if you have thrust available to assist you to maintain a safe speed during whatever departure manoeuvre is required, then use it. There have been accidents where pilots have failed to increase thrust after losing an engine during a reduced thrust take-off

There is also the not inconsiderable matter of emergency turn procedures. After controlling the aircraft post-failure, the emergency turn procedure may kick in immediately. For example, on take- off at Salzburg, towards the mountains, the emergency turn is required almost immediately. Under these circumstances, the last thing you do is fly straight ahead. If you do, you are dead. So stay alive to the needs of any emergency turns in the event of an engine failure in similar environments.

Recapitulating, in simple terms, the vital message that particularly needs reinforcing for all but is specially offered for commanders under training, is …

1. Control the aircraft.

2. Apply as much power as you have available, subject to handling control requirements. If that requires firewalling the thrust levers … do it. Hitting a mountain whilst saving the engine(s) is missing the point and WILL seriously spoil your day.

3. When under control and clear of and pointing away from limiting terrain assess the power needs and complete the emergency check lists as appropriate

4. ALWAYS remember everything is subservient to the requirement to stay alive.

A cross-wind component has the unhappy knack of spoiling things and adding to the difficulties in the circumstances, in that the track made good cannot be left to chance in this situation. An awareness of any limiting terrain should always remain an the front of minds, notwithstanding the many technical things that need to be dealt with, not the least of which is regaining the extended runway centreline and avoiding close obstacles whilst climbing at V2. During the pre-flight briefing, the departure routing required in the event of an engine failure will have been discussed, if this is not the SID then select a heading mode with the appropriate heading.

Where terrain is limiting, a GPWS may be generated, a nuisance warning in this instance even though the GPWS envelope has been infringed. If performance is marginal and terrain allows consider continuing on the extended runway centre-line until performance improves. Turns should be limited to 15º bank at V2 to avoid reduced performance. If 15º bank is insufficient to follow the required route, V2+10 will permit Rate 1 banked turns. If climb performance is marginal with the gear down, it may be desirable to delay gear retraction to avoid increased drag while the gear doors are in transit.

If the circumstances of the engine failure are such that a speed above V2 has already been achieved, then it is not necessary to reduce speed to V2 to attain the required climb performance. Retain the higher speed. If your company SOPs reflect this guidance in this situation, so well and good, but if they differ, then the SOPs must be followed, as they override this guidance. Faced with an alternative handling SOP, we suggest you attempt to get this changed.

## 7. LEVEL FLIGHT AT LOW HEIGHT

With thanks to Captain Paul Wilson FRAeS

You may have to manoeuvre at circling minima close to the ground on a bad visibility circuit after a cloud-break procedure, or if flying level whilst ill-advisedly carrying out a dive-and-drive non-precision approach, if allowed by your aircraft operator. In every case, set the trim slightly nose up so that in the event of a distraction, the aircraft will nose up and not dive into the ground.

## 8. RADIOTELEPHONY COMMUNICATIONS

Use of Standard Phraseology for all R/ T communications with Air Traffic controllers everywhere is recommended in the strongest possible manner. UK CAA CAP 413 - *Radiotelephony Manual* is the primary source of guidance on communication procedures and phraseology. This CAP reflects the EASA requirements on the subject, as they will appear on publication. CAP 413 may be found at **http://www.caa.co.uk/docs/33/CAP413.PDF** for printing or downloading. UK NATS have declared that they will monitor and report on all R/T exchanges involving misuse or non-compliance.

### 8.1 CAP 413 - Radiotelephony Manual

The aim of the UK Radiotelephony Manual (CAP 413) is to provide pilots and Air Traffic Services personnel with a compendium of clear, concise, standardised phraseology, and associated guidance, for radiotelephony communication in the United Kingdom and in European airspace.

### 8.2 Applicability of CAP 413

Radiotelephony (RTF) communications between United Kingdom air traffic services units and pilots are expected to comply with the phraseology described in this manual. Operational details can be found in the United Kingdom Aeronautical Information Publication (UK AIP). Phraseology for air traffic controllers (consistent with CAP 413) is also published in the Manual of Air Traffic Services (CAP 493). CAP 413 is also a useful reference for those studying for the UK Flight Radiotelephony Operator's Licence. Candidates for JAA pilot and instrument rating examinations should note that the syllabus for the communications examination is drawn directly from the International Civil Aviation Organisation (ICAO) Annex 10 Volume 2 and ICAO Doc 9432-AN/925 and not CAP 413.

### 8.3 CAP 413 Sources

The UK RTF Manual is based on ICAO Annex 10 Volume 2 (Communications Procedures) to the Convention on International Civil Aviation and ICAO PANS-ATM (Procedures for Air Navigation Services - Air Traffic Management) Doc. 4444. Note that if the ICAO standard phraseology may be misunderstood, or has weaknesses in the UK environment, different phraseology is specified (& notified to ICAO). Significant differences between the ICAO standard phraseology and that specified for use in CAP 413 are described hereunder.

### 8.4 CAP 413 formats

Examples of phraseology in CAP 413 are intended to be representative of communications in common use.

### 8.5 Summary of differences from ICAO Annex 10 Volume 2 (CAP 413 extracts)

| Details of ICAO/UK Difference | Reason/Remarks |
|---|---|
| Phraseology **FLIGHT LEVEL ONE ZERO ZERO** (ICAO) is not used in UK.<br><br>In the UK flight levels ending in hundreds are transmitted as **HUNDRED e.g. FLIGHT LEVEL ONE HUNDRED.** | To avoid potential confusion with adjacent flight levels and misidentification of cleared levels e.g. FLIGHT LEVEL ONE ZERO ZERO with FLIGHT LEVEL ONE ONE ZERO. |
| In the UK, the name of either the aircraft manufacturer, or name of the aircraft model, **or name of the aircraft category (e.g. helicopter or gyrocopter)** may be used as a prefix to the call-sign | To aid recognition by the ground station and/or other aircraft that the aircraft transmitting is of a particular category and may manoeuvre differently or require special handling. |
| In the UK **CONTACT** shall have the meaning **"Establish communications with... (Your details have been passed)".** | This shortens a pilot's first call on the next ATS unit/frequency, as he/she knows he/she does not have to pass full details. |
| In the UK the additional term - **FREECALL** shall have the meaning **"CALL (unit) (your details have not been passed)".** | This informs the pilot he/she will have to pass full details to the next ATS unit/frequency on first contact. |
| The phrase **GO AHEAD** (ICAO) is not used in the UK.<br><br>In the UK the term **PASS YOUR MESSAGE** is used | **GO AHEAD** is not used on safety grounds (e.g. to reduce runway incursions) where some pilots/drivers might confuse **GO AHEAD** with **PROCEED**. |
| **RE-CLEARED** (ICAO) is not used in UK. | The direction of vertical movement, provided by **CLIMB** and **DESCEND**, acts as a check in some circumstances when a pilot misinterprets a call not directed at him/her. |

| Details of ICAO/UK Difference | Reason/Remarks |
|---|---|
| **Phraseology 'CLEARED FOR ILS APPROACH'** is not routinely used in the UK.<br>In the UK, pilots will be asked to 'Report established' on the localiser; once established, they will then be given clearance to 'descend on the ILS'. In busy RTF environments, the phraseology may be combined to 'When established on the localiser, descend on the ILS...' | Due to procedure design and airspace complexity, along with lessons learned from flight safety related incidents and occurrences, the UK has elected to enhance safety by adopting unambiguous phraseology that includes a positive descent instruction to ensure that descent is initiated only when it is safe to do so. |
| **RVSM Phraseology**<br>In the UK, pilots are not required to report non- approved (RVSM) status in all requests for level changes and in all read-backs of level changes (ICAO). | This procedure is considered too cumbersome and not required as the controller has a mechanism for the status of the aircraft to be reflected. |
| **NEGATIVE, I SAY AGAIN** (ICAO) is not used in UK.<br>In the UK, if a read-back is incorrect, the aeronautical station shall transmit the word **NEGATIVE** followed by the correct version. | The phrase **I SAY AGAIN** is considered superfluous in this case. |
| The ICAO phraseology for conditional line-up clearance **FASTAIR 345, BEHIND THE DC9 ON SHORT FINAL, LINE UP BEHIND** (ICAO) is not used.<br><br>In the UK the phrase **FASTAIR 345 AFTER THE LANDING DC9 LINE UP** is used. | **AFTER** is used instead of **BEHIND** to describe more clearly 'sequential following' rather than 'further back'.<br><br>The reiteration of the condition at the end of the phrase is considered to reduce the clarity of the instruction. |
| In the UK an additional phrase, **LAND AFTER THE *(Aircraft Type)*** is used. | This phrase may be used under certain conditions and indicates that a preceding aircraft is not clear of the runway. |
| In the UK, additional phrases, **LAND AT YOUR DISCRETION** and **TAKE-OFF AT YOUR DISCRETION** are used. | These phrases may be used under certain conditions and indicate that a landing clearance or a take-off clearance cannot be issued so any landing or take-off is to be conducted at the pilot's discretion. |
| The following method of ending conversations is not used in UK :<br>**'A radiotelephone conversation shall be terminated by the receiving station using its own call-sign'** (ICAO).<br>In the UK the word **OUT** is used to indicate that the transmission has ended and no response is expected. | When there is little possibility of confusion or misunderstanding, the word **OUT** is normally omitted. |
| **Radiotelephony Reply Procedure**<br>In the UK under certain circumstances, the answering ground station may omit its call-sign. | Omitting the ground station call-sign may reduce RTF congestion and therefore improve safety standards at busy ATC units. |
| **Inter pilot air-to-air communication on 123.450 MHz and Air**-to-air communications on frequency 123.450 MHz (ICAO) are not permitted in UK. | Frequency 123.450 MHz is assigned for discrete ATC purposes within UK. |
| **Helicopter Phraseology**<br>Additional radiotelephony terms for helicopter operations are defined for use in the UK. | To reduce the possibility of misunderstanding, several additional terms pertaining to rotary wing operations are defined for use in the UK. |

| Details of ICAO/UK Difference | Reason/Remarks |
|---|---|
| **Listening Watch on 121.5 MHz**<br>ICAO Requirements for Aeronautical Station Listening Watch on VHF emergency channel 121.5 MHz are not applied in UK. | VHF emergency channel frequency 121.5 MHz is not routinely monitored at civil aerodromes, however, it is monitored *H24* at Area Control Centres with coverage over most of UK above 3000 ft amsl. |
| **Atmospheric Pressure**<br>The term **HECTOPASCAL** is not used in the UK. | When describing atmospheric pressure, the term **MILLIBAR** (Mb) is used in the UK in place of **HECTOPASCAL** (hPa) (One Millibar being equal to one Hectopascal). |
| **Line-up and wait, runway 24L**<br>Used by UK ATC | According to ICAO PANS-RAC Doc 4444, permission to enter runway and wait for take-off clearance is<br><br>**Line Up** *or*<br>**Line Up Runway *(Number)*;** or<br>**Line Up. Be Ready For Immediate Departure** |

| URGENCY & DISTRESS CALLS | Reason/Remarks |
|---|---|
| **Call Definitions**<br>**Distress**: A condition of being threatened by serious and/or imminent danger and of requiring immediate assistance.<br><br>**Urgency:** A condition concerning the safety of an aircraft or other vehicle, or of some person on board or within sight but which does not require immediate assistance. | Distress messages will be prefixed MAYDAY, MAYDAY, MAYDAY; e.g., for a medical or fuel emergency<br><br>Urgency messages will be prefixed PAN-PAN, PAN-PAN, PAN-PAN<br><br>N.B. 'PAN' is not universally understood, so be prepared to upgrade to 'MAYDAY' |
| ***The terms 'fuel emergency' and 'medical emergency' have no status in the UK and controllers are not required to give priority to aircraft with a reported shortage of fuel or medical problem unless an emergency is declared.*** | |
| **Fuel Emergency**<br>The term 'Fuel Emergency' is not recognised by ATC in the United Kingdom.<br><br>ATC cannot give priority to an aircraft with a shortage of fuel unless an emergency is declared". | ICAO/UK controllers are not permitted to give priority to an aircraft that is running low on fuel unless the call is prefixed with Pan or Mayday.<br><br>Emergency calls related to fuel shortage should be prefixed by `PAN' or `MAYDAY' as appropriate |
| **PAN** call<br>"PanPan, PanPan, PanPan", Skyliner 10, Medical Emergency".<br>or<br>"PanPan, PanPan, PanPan", Skyliner 10, Fuel Emergency | Medical Emergency<br><br>When landing at DESTINATION airfield with less than "Company Minimum Reserve" (CMR) fuel i.e. Alt fuel + Reserve fuel and anything specified in the company Ops Manual. |
| **MAYDAY** call<br>"Mayday, Mayday, Mayday, Skyliner 10, Medical Emergency".<br>or<br>"Mayday, Mayday, Mayday, Skyliner 10, Fuel Emergency". | Medical Emergency (life threatening)<br><br>When landing at <u>ANY</u> airfield with less than Reserve Fuel |

***Attention Flight Crew:*** DO NOT BE RELUCTANT to use the standard MAYDAY or PAN prefixes to inform air traffic control initially of a developing problem. If an in flight emergency occurs, the pilot in command should inform the appropriate air traffic services unit, for the information of the aerodrome authorities, of any dangerous goods on board.

If the situation permits, the information should include the proper shipping names, class and subsidiary risks for which labels are required, the compatibility group for class 1 and the quantity and location on board the aircraft of dangerous goods. (Chapter 4 of the ICAO Technical Instructions for the Safe Transport of Dangerous goods by Air)

### 8.6 FAA ATC Terminologies – Differences in interpretation

It is important to be aware that there are a number of additional differences that exist in ATC terminologies used within the 50 States of the Contiguous United States and Canada. Pilots operating in FAA controlled airspace must be aware of these differences so as not to infringe local regulations and customs. Such differences also exist where States have adopted the USA FAA Regulatory system with, in consequence, North American terms and expressions in their ATC vocabulary as established in the FAA Airman' Information Manual (AIM) Terminal Instrument Procedures (TERPS).

Vice versa, all pilots based in an FAA controlled area and who operate outside it, must be made aware of the differences in terminologies used elsewhere, to remain within the meanings of terms set by ICAO or as established in the above table, if different.

| FAA Term | Meaning & Remarks |
|---|---|
| **Maintain Runway Heading** | This means maintain the magnetic direction of the runway centreline without compensating for any wind effect induced drift. Drift correction shall NOT be applied. If you line up on 084…fly 084.<br><br>In TERPS, runway heading is just that – with no drift correction. In PANSOPS 'straight ahead' means you maintain runway track and correct for drift. The Americas, Japan, Taiwan and Korea use TERPS, the rest of the world uses PANSOPS.<br><br>Japan deviates from TERPS on this one. Here "Runway Heading" is the runway number x 10, e.g. Runway Heading for RWY 32 is 320 degrees. Not very different in practice, but JCAB is pedantic.<br><br>In areas operating to PANSOPS, pilots will compensate for drift to maintain a Track along the extended runway centreline. However exceptions exist such as Australia. So care is necessary to make sure an instruction is obeyed correctly. If unsure… ask.<br><br>The UK has changed to "Straight ahead" – a lot simpler as it means continue climbing in the take-off direction, adhering to the track of the extended runway centreline |
| **Maintain Flight Level 250**<br>Such an instruction may be given to an aircraft in the cruise at a higher Flight Level (say FL 350) | This means: When you are ready, you are cleared to descend to maintain FL 250. The airspace ahead and below you is clear of all traffic.<br><br>In the UK, the instruction is never given in such terms. The words used are **When ready, descend FL 250** (CAP 413 section 1.2.3.4 refers) |
| **On receipt of a call declaring a Fuel Emergency or a Medical emergency** | FAA controllers will recognise and react to such calls, though it may also be advisable to make a PAN or MAYDAY call as per ICAO guidance. |
| **Position and Hold**<br>is used to instruct a pilot to taxi on the departure runway in take-off position and hold.<br><br>**Example** *Tower: "N234AR Runway 24L, position and hold."*<br><br>This FAA ATC instruction is not an authorization to takeoff. | Not used by ICAO or UK. UK ATC uses<br>**Line-up and wait, runway 24L**<br><br>No mention is made to take-off in case someone thinks it is a clearance to take-off.<br><br>A take-off clearance shall be issued separately from any other clearance message |

**Here is hoping …**

I hope that this Appendix will have stirred some grey matter and given you, the prospective aircraft commander, an insight to the tools available to make you into a good leader. Enjoy your promotion, ***listen, delegate and be understanding.*** If you can achieve these three things, you are well on your way to achieving your goal of being a professional and respected aircraft commander. Remember to work and communicate instructions at a pace that will not overwhelm and stress-out your co-pilot so that he and the rest of the crew, if any, can perform at a pace within their comfort zone, without making mistakes due to stress-induced confusion and to avoid misunderstandings.

The very best of luck, but above all, "Enjoy the responsible privilege of command".

**MD 9** PD photo by Greg Goebel

**END OF APPENDIX A - APPLICATIONS**

## APPENDIX B – EUROPEAN COMMUNITY RULES ON DENIED BOARDING AND DELAYS

**Common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delay of European Community airline flights.**

This Appendix is offered to remind captains of the penalties their airline employer is liable for when passengers are delayed or denied boarding, as explained in this piece of European Legislation applicable to all EC airlines.

It may also be a useful document for you to carry and table, if you are ever involved in delays or denied boarding by some operator that is only interested in profit margins, particularly in the low cost market.

Check-in staff may need to be forcefully reminded of the European Rules contained herein, regarding compensation, hotel accommodation, meals, transport and such expenses that are incurred because of delays, diversions and cancellations, or when denied boarding.

A change of attitude should become apparent immediately the Regulation is quoted. Back your oral complaint by using a copy of these rules, for company representatives to read and note. Accept nothing less and stand on your rights.

Remember that, if your own planned flight operation service schedule is disrupted in certain circumstances, your passengers have rights for compensation that you should be aware of.

17.2.2004 EN Official Journal of the European Union L 46/1

*(Acts whose publication is obligatory)*

**REGULATION (EC) No 261/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL**

**of 11 February 2004**

**Establishing common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delay of flights, and repealing Regulation (EEC) No 295/91**
**Readers should confirm Contents by reference to latest relevant up-to-date issue**
**(Text with EEA relevance)**

**THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,**

Having regard to the Treaty establishing the European Community, and in particular Article 80(2) thereof,

Having regard to the proposal from the Commission [(1)],

Having regard to the opinion of the European Economic and Social Committee [(2)],

After consulting the Committee of the Regions,
Acting in accordance with the procedure laid down in Article 251 of the Treaty [(3)], in the light of the joint text approved by the Conciliation Committee on 1 December 2003,

Whereas:

(1) Action by the Community in the field of air transport should aim, among other things, at ensuring a high level of protection for passengers. Moreover, full account should be taken of the requirements of consumer protection in general.

(2) Denied boarding and cancellation or long delay of flights cause serious trouble and inconvenience to passengers.

(3) While Council Regulation (EEC) No 295/91 of 4 February 1991 establishing common rules for a denied boarding compensation system in scheduled air transport [(4)] created basic protection for passengers, the number of passengers denied boarding against their will remains too high, as does that affected by cancellations without prior warning and that affected by long delays.

(1) OJ C 103 E, 30.4.2002, p. 225 and OJ C 71 E, 25.3.2003, p. 188.
(2) OJ C 241, 7.10.2002, p. 29.
(3) Opinion of the European Parliament of 24 October 2002 (OJ C 300 E, 11.12.2003, p. 443), Council Common Position of 18 March 2003 (OJ C 125 E, 27.5.2003, p. 63) and Position of the European Parliament of 3 July 2003. Legislative Resolution of the European Parliament of 18 December 2003 and Council Decision of 26 January 2004.
(4) OJ L 36, 8.2.1991, p. 5.

(4) The Community should therefore raise the standards of protection set by that Regulation both to strengthen the rights of passengers and to ensure that air carriers operate under harmonised conditions in a liberalised market.

(5) Since the distinction between scheduled and non-scheduled air services is weakening, such protection should apply to passengers not only on scheduled but also on non-scheduled flights, including those forming part of package tours.

(6) The protection accorded to passengers departing from an airport located in a Member State should be extended to those leaving an airport located in a third country for one situated in a Member State, when a Community carrier operates the flight.

(7) In order to ensure the effective application of this Regulation, the obligations that it creates should rest with the operating air carrier who performs or intends to perform a flight, whether with owned aircraft, under dry or wet lease, or on any other basis.

(8) This Regulation should not restrict the rights of the operating air carrier to seek compensation from any person, including third parties, in accordance with the law applicable.

(9) The number of passengers denied boarding against their will should be reduced by requiring air carriers to call for volunteers to surrender their reservations, in exchange for benefits, instead of denying passengers boarding, and by fully compensating those finally denied boarding.

(10) Passengers denied boarding against their will should be able either to cancel their flights, with reimbursement of their tickets, or to continue them under satisfactory conditions, and should be adequately cared for while awaiting a later flight.

(11) Volunteers should also be able to cancel their flights, with reimbursement of their tickets, or continue them under satisfactory conditions, since they face difficulties of travel similar to those experienced by passengers denied boarding against their will.

(12) The trouble and inconvenience to passengers caused by cancellation of flights should also be reduced. This should be achieved by inducing carriers to inform passengers of cancellations before the scheduled time of departure and in addition to offer them reasonable rerouting, so that the passengers can make other arrangements. Air carriers should compensate passengers if they fail to do this, except when the cancellation occurs in extraordinary circumstances which could not have been avoided even if all reasonable measures had been taken.

(13) Passengers whose flights are cancelled should be able either to obtain reimbursement of their tickets or to obtain re-routing under satisfactory conditions, and should be adequately cared for while awaiting a later flight.

(14) As under the Montreal Convention, obligations on operating air carriers should be limited or excluded in cases where an event has been caused by extraordinary circumstances which could not have been avoided even if all reasonable measures had been taken. Such circumstances may, in particular, occur in cases of political instability, meteorological conditions incompatible with the operation of the flight concerned, security risks, unexpected flight safety shortcomings and strikes that affect the operation of an operating air carrier.

(15) Extraordinary circumstances should be deemed to exist where the impact of an air traffic management decision in relation to a particular aircraft on a particular day gives rise to a long delay, an overnight delay, or the cancellation of one or more flights by that aircraft, even though all reasonable measures had been taken by the air carrier concerned to avoid the delays or cancellations.

(16) In cases where a package tour is cancelled for reasons other than the flight being cancelled, this Regulation should not apply.
Passengers whose flights are delayed for a specified time should be adequately cared for and should be able to cancel their flights with reimbursement of their tickets or to continue them under satisfactory conditions.

(18) Care for passengers awaiting an alternative or a delayed flight may be limited or declined if the provision of the care would itself cause further delay.

(19) Operating air carriers should meet the special needs of persons with reduced mobility and any persons accompanying them.

(20) Passengers should be fully informed of their rights in the event of denied boarding and of cancellation or long delay of flights, so that they can effectively exercise their rights.

(21) Member States should lay down rules on sanctions applicable to infringements of the provisions of this Regulation and ensure that these sanctions are applied. The sanctions should be effective, proportionate and dissuasive.

(22) Member States should ensure and supervise general compliance by their air carriers with this Regulation and designate an appropriate body to carry out such enforcement tasks. The supervision should not affect the rights of passengers and air carriers to seek legal redress from courts under procedures of national law.

(23) The Commission should analyse the application of this Regulation and should assess in particular the opportunity of extending its scope to all passengers having a contract with a tour operator or with a Community carrier, when departing from a third country airport to an airport in a Member State.

(24) Arrangements for greater cooperation over the use of Gibraltar airport were agreed in London on 2 December 1987 by the Kingdom of Spain and the United Kingdom in a joint declaration by the Ministers of Foreign Affairs of the two countries. Such arrangements have yet to enter into operation.

(25) Regulation (EEC) No 295/91 should accordingly be repealed,

HAVE ADOPTED THIS REGULATION:

*Article 1*

**Subject**

1. This Regulation establishes, under the conditions specified herein, minimum rights for passengers when:

(a) they are denied boarding against their will;

(b) their flight is cancelled;

(c) their flight is delayed.

2. Application of this Regulation to Gibraltar airport is understood to be without prejudice to the respective legal positions of the Kingdom of Spain and the United Kingdom with regard to the dispute over sovereignty over the territory in which the airport is situated.

3. Application of this Regulation to Gibraltar airport shall be suspended until the arrangements in the Joint Declaration made by the Foreign Ministers of the Kingdom of Spain and the United Kingdom on 2 December 1987 enter into operation. The Governments of Spain and the United Kingdom will inform the Council of such date of entry into operation.

*Article 2*

**Definitions**

For the purposes of this Regulation:

(a) 'air carrier' means an air transport undertaking with a valid operating licence;

(b) 'operating air carrier' means an air carrier that performs or intends to perform a flight under a contract with a passenger or on behalf of another person, legal or natural, having a contract with that passenger;

(c) 'Community carrier' means an air carrier with a valid operating licence granted by a Member State in accordance with the provisions of Council Regulation (EEC) No 2407/92 of 23 July 1992 on licensing of air carriers [(1)];

(d) 'tour operator' means, with the exception of an air carrier, an organiser within the meaning of Article 2, point 2, of Council Directive 90/314/EEC of 13 June 1990 on package travel, package holidays and package tours [(2)];

(e) 'package' means those services defined in Article 2, point 1, of Directive 90/314/EEC;

(f) 'ticket' means a valid document giving entitlement to transport, or something equivalent in paperless form, including electronic form, issued or authorised by the air carrier or its authorised agent;

(g) 'reservation' means the fact that the passenger has a ticket, or other proof, which indicates that the reservation has been accepted and registered by the air carrier or tour operator;

(h) 'final destination' means the destination on the ticket presented at the check-in counter or, in the case of directly connecting flights, the destination of the last flight; alternative connecting flights available shall not be taken into account if the original planned arrival time is respected;

(i) 'person with reduced mobility' means any person whose mobility is reduced when using transport because of any physical disability (sensory or locomotory, permanent or temporary), intellectual impairment, age or any other cause of disability, and whose situation needs special attention and adaptation to the person's needs of the services made available to all passengers;

(j) 'denied boarding' means a refusal to carry passengers on a flight, although they have presented themselves for boarding under the conditions laid down in Article 3(2),except where there are reasonable grounds to deny them boarding, such as reasons of health, safety or security, or inadequate travel documentation;

(k) 'volunteer' means a person who has presented himself for boarding under the conditions laid down in Article 3(2) and responds positively to the air carrier's call for passengers prepared to surrender their reservation in exchange for benefits.

(l) 'cancellation' means the non-operation of a flight which was previously planned and on which at least one place was reserved.

---

(1) OJ L 240, 24.8.1992, p. 1.
(2) OJ L 158, 23.6.1990, p. 59.

---

*Article 3*

**Scope**

1. This Regulation shall apply:

(a) to passengers departing from an airport located in the territory of a Member State to which the Treaty applies;

(b) to passengers departing from an airport located in a third country to an airport situated in the territory of a Member State to which the Treaty applies, unless they received benefits or compensation and were given assistance in that third country, if the operating air carrier of the flight concerned is a Community carrier.

2. Paragraph 1 shall apply on the condition that/those passenger(s).

(a) have a confirmed reservation on the flight concerned and, except in the case of cancellation referred to in Article 5, present themselves for check-in,

— as stipulated and at the time indicated in advance and in writing (including by electronic means) by the air carrier, the tour operator or an authorised travel agent,

or, if no time is indicated,

— not later than 45 minutes before the published departure time; or

(b) have been transferred by an air carrier or tour operator from the flight for which they held a reservation to another flight, irrespective of the reason.

3. This Regulation shall not apply to passengers travelling free of charge or at a reduced fare not available directly or indirectly to the public. However, it shall apply to passengers having tickets issued under a frequent flyer programme or other commercial programme by an air carrier or tour operator.

4. This Regulation shall only apply to passengers transported by motorised fixed wing aircraft.

5. This Regulation shall apply to any operating air carrier providing transport to passengers covered by paragraphs 1 and 2. Where an operating air carrier which has no contract with the passenger performs obligations under this Regulation, it shall be regarded as doing so on behalf of the person having a contract with that passenger.

6. This Regulation shall not affect the rights of passengers under Directive 90/314/EEC. This Regulation shall not apply in cases where a package tour is cancelled for reasons other than cancellation of the flight.

*Article 4*

**Denied boarding**

1. When an operating air carrier reasonably expects to deny boarding on a flight, it shall first call for volunteers to surrender their reservations in exchange for benefits under conditions to be agreed between the passenger concerned and the operating air carrier. Volunteers shall be assisted in accordance with Article 8, such assistance being additional to the benefits mentioned in this paragraph.

2. If an insufficient number of volunteers come forward to allow the remaining passengers with reservations to board the flight, the operating air carrier may then deny boarding to passengers against their will.

3. If boarding is denied to passengers against their will, the operating air carrier shall immediately compensate them in accordance with Article 7 and assist them in accordance with Articles 8 and 9.

*Article 5*

**Cancellation**

1. In case of cancellation of a flight, the passengers Concerned shall:

(a) be offered assistance by the operating air carrier in accordance with Article 8; and

(b) be offered assistance by the operating air carrier in accordance with Article 9(1)(a) and 9(2), as well as, in event of rerouting when the reasonably expected time of departure of the new flight is at least the day after the departure as it was planned for the cancelled flight, the assistance specified in Article 9(1)(b) and 9(1)(c); and

(c) have the right to compensation by the operating air carrier in accordance with Article 7, unless:

(i) they are informed of the cancellation at least two weeks before the scheduled time of departure; or

(ii) they are informed of the cancellation between two weeks and seven days before the scheduled time of departure and are offered re-routing, allowing them to depart no more than two hours before the scheduled time of departure and to reach their final destination less than four hours after the scheduled time of arrival;

or

(iii) they are informed of the cancellation less than seven days before the scheduled time of departure and are offered re-routing, allowing them to depart no more than one hour before the scheduled time of departure and to reach their final destination less than two hours after the scheduled time of arrival.

2. When passengers are informed of the cancellation, an explanation shall be given concerning possible alternative transport.

3. An operating air carrier shall not be obliged to pay compensation in accordance with Article 7, if it can prove that the cancellation is caused by extraordinary circumstances which could not have been avoided even if all reasonable measures had been taken.

4. The burden of proof concerning the questions as to whether and when the passenger has been informed of the cancellation of the flight shall rest with the operating air carrier.

*Article 6*

**Delay**

1. When an operating air carrier reasonably expects a flight to be delayed beyond its scheduled time of departure:

(a) for two hours or more in the case of flights of 1,500 kilometres or less; or

(b) for three hours or more in the case of all intra-Community flights of more than 1,500 kilometres and of all other flights between 1,500 and 3,500 kilometres; or

(c) for four hours or more in the case of all flights not falling under (a) or (b), passengers shall be offered by the operating air carrier:

(i) the assistance specified in Article 9(1)(a) and 9(2); and

(ii) when the reasonably expected time of departure is at least the day after the time of departure previously announced, the assistance specified in Article 9(1)(b) and 9(1)(c); and (iii) when the delay is at least five hours, the assistance specified in Article 8(1)(a).

2. In any event, the assistance shall be offered within the time limits set out above with respect to each distance bracket.

*Article 7*

**Right to compensation**

1. Where reference is made to this Article, passengers shall receive compensation amounting to:

(a) EUR 250 for all flights of 1,500 kilometres or less;

(b) EUR 400 for all intra-Community flights of more than 1,500 kilometres, and for all other flights between 1,500and 3,500 kilometres;

(c) EUR 600 for all flights not falling under (a) or (b).

In determining the distance, the basis shall be the last destination at which the denial of boarding or cancellation will delay the passenger's arrival after the scheduled time.

2. When passengers are offered re-routing to their final destination on an alternative flight pursuant to Article 8, the arrival time of which does not exceed the scheduled arrival time of the flight originally booked

(a) by two hours, in respect of all flights of 1,500 kilometres or less; or

(b) by three hours, in respect of all intra-Community flights of more than 1,500 kilometres and for all other flights between 1,500 and 3,500 kilometres; or

(c) by four hours, in respect of all flights not falling under (a) or (b), the operating air carrier may reduce the compensation provided for in paragraph 1 by 50 %.

3. The compensation referred to in paragraph 1 shall be paid in cash, by electronic bank transfer, bank orders or bank cheques or, with the signed agreement of the passenger, in travel vouchers and/or other services.

4. The distances given in paragraphs 1 and 2 shall be measured by the great circle route method.

*Article 8*

**Right to reimbursement or re-routing**

1. Where reference is made to this Article, passengers shall be offered the choice between:

(a) — reimbursement within seven days, by the means provided for in Article 7(3), of the full cost of the ticket at the price at which it was bought, for the part or parts of the journey not made, and for the part or parts already made if the flight is no longer serving any purpose in relation to the passenger's original travel plan, together with, when relevant,

— a return flight to the first point of departure, at the earliest opportunity;

(b) re-routing, under comparable transport conditions, to their final destination at the earliest opportunity; or

(c) re-routing, under comparable transport conditions, to their final destination at a later date at the passenger's convenience, subject to availability of seats.

2. Paragraph 1(a) shall also apply to passengers whose flights form part of a package, except for the right to reimbursement where such right arises under Directive 90/314/EEC.

3. When, in the case where a town, city or region is served by several airports, an operating air carrier offers a passenger a flight to an airport alternative to that for which the booking was made, the operating air carrier shall bear the cost of transferring the passenger from that alternative airport either to that for which the booking was made, or to another close-by destination agreed with the passenger.

*Article 9*

**Right to care**

1. Where reference is made to this Article, passengers shall be offered free of charge:

(a) meals and refreshments in a reasonable relation to the waiting time;

(b) hotel accommodation in cases

— where a stay of one or more nights becomes necessary,

or

— where a stay additional to that intended by the passenger becomes necessary;

(c) transport between the airport and place of accommodation (hotel or other).

2. In addition, passengers shall be offered free of charge two telephone calls, telex or fax messages, or e-mails.

3. In applying this Article, the operating air carrier shall pay particular attention to the needs of persons with reduced mobility and any persons accompanying them, as well as to the needs of unaccompanied children.

*Article 10*

**Upgrading and downgrading**

1. If an operating air carrier places a passenger in a class higher than that for which the ticket was purchased, it may not request any supplementary payment.

2. If an operating air carrier places a passenger in a class lower than that for which the ticket was purchased, it shall within seven days, by the means provided for in Article 7(3), reimburse

(a) 30 % of the price of the ticket for all flights of,1 500 kilometres or less, or

(b) 50 % of the price of the ticket for all intra-Community flights of more than 1,500 kilometres, except flights between the European territory of the Member States and the French overseas departments, and for all other flights between 1,500 and 3,500 kilometres, or

(c) 75 % of the price of the ticket for all flights not falling under (a) or (b), including flights between the European territory of the Member States and the French overseas departments.

*Article 11*

**Persons with reduced mobility or special needs**

1. Operating air carriers shall give priority to carrying persons with reduced mobility and any persons or certified service dogs accompanying them, as well as unaccompanied children.

2. In cases of denied boarding, cancellation and delays of any length, persons with reduced mobility and any persons accompanying them, as well as unaccompanied children, shall have the right to care in accordance with Article 9 as soon as possible.

*Article 12*

**Further compensation**

1. This Regulation shall apply without prejudice to a passenger's rights to further compensation. The compensation granted under this Regulation may be deducted from such compensation.

2. Without prejudice to relevant principles and rules of national law, including case-law, paragraph 1 shall not apply to passengers who have voluntarily surrendered a reservation under Article 4(1).

*Article 13*

**Right of redress**

In cases where an operating air carrier pays compensation or meets the other obligations incumbent on it under this Regulation, no provision of this Regulation may be interpreted as restricting its right to seek compensation from any person, including third parties, in accordance with the law applicable. In particular, this Regulation shall in no way restrict the operating air carrier's right to seek reimbursement from a tour operator or another person with whom the operating air carrier has a contract. Similarly, no provision of this Regulation may be interpreted as restricting the right of a tour operator or a third party, other than a passenger, with whom an operating air carrier has a contract, to seek reimbursement or compensation from the operating air carrier in accordance with applicable relevant laws.

*Article 14*

**Obligation to inform passengers of their rights**

1. The operating air carrier shall ensure that at check-in a clearly legible notice containing the following text is displayed in a manner clearly visible to passengers: ‘If you are denied boarding or if your flight is cancelled or delayed for at least two hours, ask at the check-in counter or boarding gate for the text stating your rights, particularly with regard to compensation and assistance’.

2. An operating air carrier denying boarding or cancelling a flight shall provide each passenger affected with a written notice setting out the rules for compensation and assistance in line with this Regulation. It shall also provide each passenger affected by a delay of at least two hours with an equivalent notice. The contact details of the national designated body referred to in Article 16 shall also be given to the passenger in written form.

3. In respect of blind and visually impaired persons, the provisions of this Article shall be applied using appropriate alternative means.

*Article 15*

**Exclusion of waiver**

1. Obligations vis-à-vis passengers pursuant to this Regulation may not be limited or waived, notably by a derogation or restrictive clause in the contract of carriage.

2. If, nevertheless, such a derogation or restrictive clause is applied in respect of a passenger, or if the passenger is not correctly informed of his rights and for that reason has accepted compensation which is inferior to that provided for in this Regulation, the passenger shall still be entitled to take the necessary proceedings before the competent courts or bodies in order to obtain additional compensation.

*Article 16*

**Infringements**

1. Each Member State shall designate a body responsible for the enforcement of this Regulation as regards flights from airports situated on its territory and flights from a third country to such airports. Where appropriate, this body shall take the measures necessary to ensure that the rights of passengers are respected. The Member States shall inform the Commission of the body that has been designated in accordance with this paragraph.

2. Without prejudice to Article 12, each passenger may complain to any body designated under paragraph 1, or to any other competent body designated by a Member State, about an alleged infringement of this Regulation at any airport situated on the territory of a Member State or concerning any flight from a third country to an airport situated on that territory.

— the incidence of denied boarding and of cancellation of flights,

— the possible extension of the scope of this Regulation to passengers having a contract with a Community carrier or holding a flight reservation which forms part of a ‘package tour’ to which Directive 90/314/EEC applies and who depart from a third-country airport to an airport in a Member State, on flights not operated by Community air carriers,

— the possible revision of the amounts of compensation referred to in Article 7(1).

The report shall be accompanied where necessary by legislative proposals.

3. The sanctions laid down by Member States for infringements of this Regulation shall be effective, proportionate and dissuasive.

*Article 17*

**Report**

The Commission shall report to the European Parliament and the Council by 1 January 2007 on the operation and the results of this Regulation, in particular regarding:

*Article 18*

**Repeal**

Regulation (EEC) No 295/91 shall be repealed.

*Article 19*

**Entry into force**

This Regulation shall enter into force on 17 February 2005.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Strasbourg, 11 February 2004
For the European Parliament
The President
P. COX

For the Council
The President
M. McDOWELL
17.2.2004 EN Official Journal of the European Union
46/7

**END OF APPENDIX B**

## APPENDIX C - WINTER OPERATIONS

### EU-OPS 1, SECTION 2 – ACCEPTABLE MEANS OF COMPLIANCE (AMC) & INTERPRETATIVE EXPLANATORY MATERIAL (IEM)

***OPS 1.3 5* - Ice and other contaminants — ground procedures**

(a) An operator shall establish procedures to be followed when ground de-icing and anti-icing together with related inspections of the aeroplane(s) are necessary.

(b) A commander shall not commence take-off unless the external surfaces are clear of any deposits which might adversely affect the performance and/or controllability of the aeroplane except as permitted in the Aeroplane Flight Manual.

**OPS 1.346 - Ice and other contaminants — flight procedures**

(a) An operator shall establish procedures for flights in expected or actual icing conditions.

(b) A commander shall not commence a flight nor intentionally fly into expected or actual icing conditions unless the aeroplane is certificated and equipped to cope with such conditions.

**OPS 1.675 - Equipment for operations in icing conditions**

(a) An operator shall not operate an aeroplane in expected or actual icing conditions unless it is certificated and equipped to operate in icing conditions.

(b) An operator shall not operate an aeroplane in expected or actual icing conditions at night unless it is equipped with a means to illuminate or detect the formation of ice. Any illumination that is used must be of a type that will not cause glare or reflection that would handicap crew members in the performance of their duties.

### MEANS OF COMPLIANCE

**Acceptable Means of Compliance (AMC)** illustrates the means, or several alternative means, but not necessarily the only possible means by which a requirement can be met. It should however be noted that where a new AMC is developed, any such AMC (which may be additional to an existing AMC) will be amended into the document following consultation under the NPA procedure.

**Interpretative/Explanatory Material (IEM)** helps to illustrate the meaning of a requirement

Pilots should make themselves thoroughly familiar with procedures that are to be followed when operating in icing conditions. Such pre flight and in-flight procedures must be covered in the Operations Manual. This should be so written as to satisfy EU-OPS 1.345 Requirements that are contained in the following AMC *(*Acceptable Means of Compliance) extract on the subject.

### Procedures

**1. General**

a. Any deposit of frost, ice, snow or slush on the external surfaces of an aeroplane may drastically affect its flying qualities, because of reduced aerodynamic lift and increased drag that modify stability and control characteristics. Furthermore, freezing deposits may cause moving parts, such as elevators, ailerons, flap actuating mechanism etc., to jam and create a potentially hazardous condition. Propeller and engine or APU systems performance may deteriorate due to the presence of frozen contaminants to blades, intakes and components. Also, engine operation may be seriously affected by the ingestion of snow or ice, thereby causing engine stall or compressor damage. In addition, ice/frost may form on certain external surfaces (e.g. wing upper and lower surfaces, etc.) due to the effects of cold fuel and structures, even in ambient temperatures well above 0° C.

b. The procedures established by the operator for de-icing and/or anti-icing in accordance with EU-OPS 1.345 and 1.346, are intended to ensure that the aeroplane is clear of contamination. This is necessary so that degradation of aerodynamic characteristics or mechanical interference will not occur and, following anti-icing, to maintain the airframe in that condition during the appropriate holdover time. The de-icing and/or anti-icing procedures should therefore include requirements, including type-specific, taking into account manufacturer's recommendations and cover:

   (i) Contamination checks, including detection of clear ice and under-wing frost. (Note: limits on the thickness/area of contamination published in the AFM or other manufacturers' documentation must be followed);

   (ii) De-icing and/or anti-icing procedures, including procedures to be followed if de-icing and/or anti-icing procedures are interrupted or unsuccessful; or the prevailing conditions have changed (see (c) below)

(iii) Post treatment checks;
(iv Pre take-off checks;
(v) Pre take-off contamination checks;
(vi The recording of any incidents relating to de-icing and/or anti-icing; and
(vii) The responsibilities of all personnel involved in de-icing and/or anti-icing.

c. Under certain meteorological conditions de-icing and/or anti-icing procedures may be ineffective in providing sufficient protection for continued operations. Examples of these conditions are freezing rain, ice pellets and hail, heavy snow, high wind velocity, fast dropping OAT or any time when freezing precipitation with high water content is present. No holdover- time guidelines exist for these conditions.

d. Material for establishing operational procedures can be found, for example, in:

- ICAO Annex 3, Meteorological Service for International Air Navigation;
- ICAO Doc 9640-AN/940"Manual of aircraft ground de-icing/anti-icing operations";
- ISO 11075 (*) ISO Type I fluid;
- ISO 11076 (*) Aircraft de-icing/anti-icing methods with fluids;
- ISO 11077 (*) Self propelled de-icing/anti-icing vehicles-functional requirements;
- ISO 11078 (*) ISO Type II fluid;
- AEA "Recommendations for de-icing/anti-icing of aircraft on the ground";
- AEA "Training recommendations and background information for de-icing/anti-icing of aircraft on the ground";
- EUROCAE ED-104/SAE AS 5116 Minimum operational performance specification for ground ice detection systems;
- SAE ARP 4737 - Aircraft de-icing/anti-icing methods;
- SAE AMS 1424 - Type I fluids;
- SAE AMS 1428 - Type II, III and IV fluids;
- SAE ARP 1971 - Aircraft De-icing Vehicle, Self-Propelled, Large and Small Capacity;
- SAE ARD 50102 - Forced air or forced air/fluid equipment for removal of frozen contaminants;
- SAE ARP 5149 - Training Programme Guidelines for De-icing/Anti-icing of Aircraft on Ground.

(*) *The revision cycle of ISO documents is infrequent and therefore the documents quoted may not reflect the latest industry standards*.

**2. Terminology**

Terms used in the context of this ACJ have the following meanings. Explanations of other definitions may be found elsewhere in the documents listed in 1d. In particular, meteorological definitions may be found in ICAO Doc. 9640.

a. Anti-icing: The procedure that provides protection against the formation of frost or ice and snow accumulation on treated surfaces of the aeroplane for a limited period of time (holdover time).

b. Anti-icing fluid: Anti-icing fluid includes but is not limited to the following:

(i) Type I fluid if heated to min 60° C at the nozzle;
(ii) Mixture of water and Type I fluid if heated to min 60°C at the nozzle;
(iii) Type II fluid;
(iv Mixture of water and Type II fluid;
(v) Type III fluid;
(vi) Mixture of water and Type III fluid;
(vii) Type IV fluid;
(viii) Mixture of water and Type IV fluid.

**Note:** On uncontaminated aeroplane surfaces Type II, III and IV anti-icing fluids are normally applied unheated.

c. Clear ice: A coating of ice, generally clear and smooth, but with some air pockets. It forms on exposed objects, the temperature of which are at, below or slightly above the freezing temperature, by the freezing of super-cooled drizzle, droplets or raindrops.

d. Conditions conducive to aeroplane icing on the ground: Freezing fog, freezing precipitation, frost, rain or high humidity (on cold soaked wings), mixed rain and snow and snow.

e. Contamination: Contamination in this context is understood as all forms of frozen or semi-frozen moisture such as frost, snow, slush, or ice.

f. Contamination check: Check of aeroplane for contamination to establish the need for de-icing.

g. De-icing: The procedure by which frost, ice, snow or slush is removed from an aeroplane in order to provide uncontaminated surfaces.

h. De-icing fluid: Such fluid includes, but is not limited to, the following:
   (i) Heated water;
   (ii) Type I fluid;
   (iii) Mixture of water and Type I fluid;
   (iv Type II fluid;
   (v) Mixture of water and Type II fluid;
   (vi Type III fluid;
   (vii) Mixture of water and Type III fluid;
   (viii) Type IV fluid;
   (ix) Mixture of water and Type IV fluid.

**Note**: De-icing fluid is normally applied heated, to ensure maximum efficiency.

i. De-icing/anti-icing. This is the combination of de-icing and anti-icing performed in either one or two steps.

j. Ground Ice Detection System (GIDS). System used during aeroplane ground operations to inform the ground crew and/or the flight crew about the presence of frost, ice, snow or slush on the aeroplane surfaces.

k. Holdover time (HOT). The estimated period of time for which an anti-icing fluid is expected to prevent the formation of frost or ice and the accumulation of snow on the treated surfaces of an aeroplane, on the ground, in the prevailing ambient conditions.

l. Lowest Operational Use Temperature (LOUT). The lowest temperature at which a fluid has been tested and certified as acceptable; in accordance with the appropriate aerodynamic acceptance test and whilst still maintaining a freezing point buffer of not less than:

   10° C for a type I de-icing/anti-icing fluid; and
   7° C for type II, III or IV de/anti-icing fluids.

m. Post treatment check. An external check of the aeroplane after de-icing and/or anti-icing treatment accomplished from suitably elevated observation points (e.g. from the de-icing equipment itself or other elevated equipment) to ensure that the aeroplane is free from any frost, ice, snow, or slush.

n. Pre-take-off check. An assessment normally performed from within the flight deck, to validate the applied holdover time.

o. Pre-take-off contamination check. A check of the treated surfaces for contamination, performed when the hold-over-time has been exceeded or if any doubt exists regarding the continued effectiveness of the applied anti-icing treatment. It is normally accomplished externally, just before the commencement of the take-off run, by appropriately qualified ground staff.

**3. Fluids**

a. Type I fluid. Due to its properties, Type I fluid forms a thin, liquid-wetting film on surfaces to which it is applied which, under certain weather conditions, gives a very limited holdover time. With this type of fluid, increasing the concentration of fluid in the fluid/water mix does not provide any extension in holdover time.

b. Type II and type IV fluids contain thickeners which enable the fluid to form a thicker liquid-wetting film on surfaces to which it is applied. Generally, this fluid provides a longer holdover time than Type I fluids in similar conditions. With this type of fluid, the holdover time can be extended by increasing the ratio of fluid in the fluid/water mix.

c. Type III fluid: a thickened fluid intended especially for use on aeroplanes with low rotation speeds.

d. Fluids used for de-icing and/or anti-icing should be acceptable to the operator and the aeroplane manufacturer. These fluids normally conform to specifications such as SAE AMS 1424, 1428 or equivalent. Use of non-conforming fluids is not recommended, due to their characteristics not being known.

**Note**: The anti-icing and aerodynamic properties of thickened fluids may be seriously degraded by, for example, inappropriate storage, treatment, application, application equipment and age.

**4. Communications**

4.1 Before aeroplane treatment.

When the aeroplane is to be treated with the flight crew on board, the flight and ground crews should confirm the fluid to be used, the extent of treatment required, and any aeroplane type specific procedure(s) to be used. Any other information needed to apply the HOT tables should be exchanged. Particular attention must be paid to the provision of air conditioning services, to ensure that fluid application does not enter the aircraft pneumatic system.

4.2 Anti-icing code

a. The operator's procedures should include an anti-icing code, which indicates the treatment the aeroplane has received. This code provides the flight crew with the minimum details necessary to estimate a holdover time (see in (5) below) and confirms that the aeroplane is free of contamination. Flight crew may find this code already entered into the Aircraft Technical Log, or on a note attached to the flight control system.

b. The procedures for releasing the aeroplane after the treatment should therefore provide the Commander with the anti-icing code and it is essential that the Commander has a clear understanding of the commencement time.

c. Anti-icing Codes to be used (examples):

(i) "Type I" at (start time) – To be used if anti-icing treatment has been performed with a Type I fluid;

(ii) "Type II/100" at (start time) – To be used if anti-icing treatment has been performed with undiluted Type II fluid;

(iii) "Type II/75" at (start time) – To be used if anti-icing treatment has been performed with a mixture of 75% Type II fluid and 25% water;

(iv) "Type IV/50" at (start time) – To be used if anti-icing treatment has been performed with a mixture of 50% Type IV fluid and 50% water.

**Note 1:** When a two-step de-icing/anti-icing operation has been carried out, the Anti-Icing Code is determined by the second step fluid. Fluid brand names may be included, if desired

**Note 2:** If the treatment is compromised by any factor, such as the supply side running-out or the conditions changing then, unless the need for the treatment ceases, the whole process must re-commence with a revised start time passed to the flight crew.

4.3 After Treatment

Before reconfiguring or moving the aeroplane, the flight crew should receive a confirmation from the ground crew that all de-icing and/or anti-icing operations are complete and that all personnel and equipment are clear of the aeroplane.

**5. Holdover protection**

a. Holdover protection is achieved by a layer of anti-icing fluid remaining on and protecting aeroplane surfaces for a specified period of time. With a one-step de-icing/anti-icing procedure, the holdover time (HOT) begins at the commencement of de-icing/anti-icing. With a two-step procedure, the holdover time begins at the commencement of the second (anti-icing) step. The holdover protection runs out:

(i) At the commencement of take-off roll (due to aerodynamic shedding of fluid), or

(ii) When frozen deposits start to form or accumulate on treated aeroplane surfaces, thereby indicating the loss of effectiveness of the fluid.

b. The duration of holdover protection may vary, subject to the influence of factors other than those specified in the holdover time (HOT) tables. Guidance should be provided by the operator to take account of such factors which may include:

(i) Atmospheric conditions, e.g. exact type and rate of precipitation, wind direction and velocity, relative humidity and solar radiation and

(ii) The aeroplane and its surroundings, such as aeroplane component inclination angle, contour and surface roughness, surface temperature, operation in close proximity to other aeroplanes (jet or propeller blast) and ground equipment and structures.

c. Holdover times are not meant to imply that flight is safe in the prevailing conditions if the specified holdover time has not been exceeded. Certain meteorological conditions, such as freezing drizzle or freezing rain, may be beyond the certification envelope of the aeroplane.

d. The operator should publish in the Operations Manual the holdover times in the form of a table or diagram to account for the various types of ground icing conditions; together with the different types and concentrations of fluids used. However, the times of protection shown in these tables are to be used as guidelines only and are normally used in conjunction with pre-take-off check.

e. References to usable HOT tables may be found in the 'AEA recommendations for de-/anti-icing aircraft on the ground'.

f. Flight crew need to establish knowledge of their aircraft type and external locations where icing conditions will have the most significant impact. For instance 'dry bays' on the top surfaces of wings will not benefit from the heating effect of uploaded fuel and remain covered in frost or ice when surrounding wing surfaces will have become clear.

**6. Procedures to be used**

Operator's procedures should ensure that:

a. When aeroplane surfaces are contaminated by ice, frost, slush or snow, they are de-iced prior to take-off; according to the prevailing conditions. Removal of contaminants may be performed with mechanical tools, fluids (including hot water), infra-red heat or forced air, taking account of aeroplane type-specific requirements.

b. Account is taken of the wing skin temperature versus OAT, as this may affect:

(i) The need to carry out aeroplane de-icing and/or anti-icing; and

(ii) The performance of the de-icing/anti-icing fluids.

c. When freezing precipitation occurs, or there is a risk of freezing precipitation occurring, which would contaminate the surfaces at the time of take-off, aeroplane surfaces should be anti-iced. If both de-icing and anti-icing are required, the procedure may be performed in a one or two-step process depending upon weather conditions, available equipment, available fluids and the desired holdover time. One-step de-icing/anti-icing means that de-icing and anti-icing are carried out at the same time using a mixture of de-icing/anti-icing fluid and water. Two-step de-icing/anti-icing means that de-icing and anti-icing are carried out in two separate steps. The aeroplane is first de-iced using heated water only or a heated mixture of de-icing/anti-icing fluid and water. After completion of the de-icing operation, a layer of a mixture of de-icing/anti-icing fluid and water, or of de-icing/anti-icing fluid only, is to be sprayed over the aeroplane surfaces. The second step will be applied, before the first step fluid freezes, typically within three minutes and, if necessary, area by area.

d. When an aeroplane is anti-iced and a longer holdover time is needed or desired, the use of a less diluted Type II or Type IV fluid should be considered.

e. All restrictions relative to Outside Air Temperature (OAT) and fluid application (including, but not necessarily limited to temperature and pressure), published by the fluid manufacturer and/or aeroplane manufacturer, must be followed. Procedures, limitations and recommendations to prevent the formation of fluid residues must also be followed.

f. During conditions conducive to aeroplane icing on the ground, or after de-icing and/or anti-icing, an aeroplane is not dispatched for departure unless it has been given a contamination check or a post treatment check by a trained and qualified person. This check should cover all treated surfaces of the aeroplane and be performed from points offering sufficient accessibility to these parts. To ensure that there is no clear ice on suspect areas, it may be necessary to make a physical check (e.g. tactile).

g. The required entry is made in the Technical Log. (See AMC OPS 1.915, paragraph 2, Section 3.vi.)

h. The Commander continually monitors the environmental situation after the performed treatment. Prior to take-off he performs a pre-take-off check, which is an assessment whether the applied HOT is still appropriate. This pre-take-off check includes, but is not limited to, factors such as precipitation, wind and OAT.

i. If any doubt exists as to whether a deposit may adversely affect the aeroplane's performance and/or controllability characteristics, the Commander should require a pre-take-off contamination check to be performed, in order to verify that the aeroplane's surfaces are free of contamination. Special methods and/or equipment may be necessary to perform this check, especially at night time or in extremely adverse weather conditions. If this check cannot be performed just prior take-off, re- treatment should be carried out.

j. When re-treatment is necessary, any residue of the previous treatment should be removed and a completely new de-icing/anti-icing treatment applied.

k. When a Ground Ice Detection System (GIDS) is used to perform an aeroplane surfaces check prior to and/or after a treatment, the use of GIDS by suitably trained personnel should be a part of the procedure.

**7. Special operational considerations**

a. When using thickened de-icing/anti-icing fluids, the operator should consider a two-step de-icing/anti-icing procedure, the first step preferably with hot water and/or non thickened fluids.

b. The use of de-icing/anti-icing fluids has to be in accordance with the aeroplane manufacturer's documentation. This is particular true for thickened fluids to assure sufficient flow-off during take-off.

c. The operator should comply with any type-specific operational requirement(s) such as an aeroplane mass decrease and/or a take-off speed increase associated with a fluid application.

d. The operator should take into account any flight handling procedures (stick force, rotation speed and rate, take-off speed, aeroplane attitude etc.) laid down by the aeroplane manufacturer when associated with a fluid application.

e. The limitations or handling procedures resulting from (c) and/or (d) above should be part of the flight crew pre take-off briefing. For example, Graduated/Reduced Take-off Power should not be used unless specifically aircraft type-approved.

f. There may be 'aircraft type-specific', passenger and crew air conditioning procedures during de-icing/anti-icing and passengers will need to be prepared by a PA call, made by the flight or cabin crew

**8. Special maintenance considerations**

a. General

The operator should take proper account of the possible side-effects of fluid use. Such effects may include, but are not necessarily limited to, dried and/or re-hydrated residues, corrosion and the removal of lubricants. Appropriate Personal Protective Equipment must be provided and used.

b. Special considerations due to residues of dried fluids.

The operator should establish procedures to prevent or detect and remove residues of dried fluid. If necessary the operator should establish appropriate inspection intervals based on the airframe manufacturers and/or own experience and recommendations:

(i) *Dried fluid residues:* Dried fluid residue could occur when surfaces have been treated but the aircraft has not been flown subsequently and not been subject to precipitation. The fluid may then have dried on the surfaces;

(ii) *Re-hydrated fluid residues:* Repetitive application of thickened de-icing/anti-icing fluids may lead to the subsequent formation/build up of a dried residue in aerodynamically quiet areas, such as cavities and gaps. This residue may re-hydrate if exposed to high humidity conditions, precipitation, washing, etc., and increase to many times its original size/volume. This residue will freeze if exposed to conditions at or below 0° C. This may cause moving parts such as elevators, ailerons, and flap actuating mechanisms to stiffen or jam in flight.

Re-hydrated residues may also form on exterior surfaces, which can reduce lift, increase drag and stall speed.

Re-hydrated residues may also collect inside control surface structures and cause clogging of drain holes or imbalances to flight controls.

Residues may also collect in hidden areas: around flight control hinges, pulleys, grommets, on cables and in gaps.

(iii) Recommendation

Operators are strongly recommended to request information about the fluid dry-out and of the rehydration characteristics from the fluid manufacturers and to select products with optimised characteristics;

(iv) Additional information

Additional information should be obtained from fluid manufacturers for handling, storage, application and testing of their products.

**9. Training**

a. An operator must establish appropriate initial and recurrent de-icing and/or anti-icing training programmes (including communication training) for flight crew; and those of his ground crew who are involved in de-icing and/or anti-icing.

b. These de-icing and/or anti-icing training programmes must include additional training if any of the following will be introduced:

(i) A new method, procedure and/or technique;

(ii) A new type of fluid and/or equipment; and

(iii) A new type(s) of aeroplane.

**10. Subcontracting** (see AMC OPS 1.035 sections 4 and 5)

The operator must ensure that the subcontractor complies with the operator's quality and training and qualification requirements, together with the special requirements in respect of:

a. De-icing and/or anti-icing methods and procedures;

b. Fluids to be used, including provision and availability of supplies, precautions for storage and preparation for use;

c. Specific aeroplane requirements (e.g. no-spray areas, propeller/engine de-icing, APU operation etc.);

d. Checking and communications procedures.

**11. Flight in expected or actual icing conditions**

11.1 The procedures to be established by an operator should take account of the design, the equipment or the configuration of the aeroplane and also of the training which is needed. For these reasons, different aeroplane types operated by the same company may require the development of different procedures. In every case, the relevant limitations are those which are defined in the Aeroplane Flight Manual (AFM) and other documents produced by the manufacturer.

11.2 For the required entries in the Operations Manual, the procedural principles which apply to flight in icing conditions are referred to under Appendix 1 to OPS 1.1045, A 8.3.8 and should be cross-referenced, where necessary, to supplementary, type-specific data under B 4.1.1.

11.3. **Technical content of the Procedures**.

The operator should ensure that the procedures take account of the following:

a. OPS 1.675;

b. The equipment and instruments which must be serviceable for flight in icing conditions;

c. The limitations on flight in icing conditions for each phase of flight. These limitations may be imposed by the aeroplane's de-icing or anti-icing equipment, or the necessary performance corrections which have to be made;

d. The criteria the Flight Crew should use to assess the effect of icing on the performance and/or controllability of the aeroplane;

e. The means by which the Flight Crew detects, by visual cues or the use of the aeroplane's ice detection system, that the flight is entering icing conditions; and

f. The action to be taken by the Flight Crew in a deteriorating situation (which may develop rapidly) resulting in an adverse affect on the performance and/or controllability of the aeroplane, due to either:
   (i) the failure of the aeroplane's anti-icing or de-icing equipment to control a build-up of ice, and/or
   (ii) ice build-up on unprotected areas.

**12. Training for despatch and flight in expected or actual icing conditions.**

The content of the Operations Manual, Part D, should reflect the training, both conversion and recurrent, which Flight Crew, Cabin Crew and all other relevant operational personnel will require in order to comply with the procedures for despatch and flight in icing conditions.

12.1 For the Flight Crew, the training should include:

a. Instruction in how to recognise, from weather reports or forecasts which are available before flight commences, or during flight, the risks of encountering icing conditions along the planned route and on how to modify, as necessary, the departure and in-flight routes or profiles;

b. Instruction in the operational and performance limitations or margins;

c. The use of in-flight ice detection, anti-icing and de-icing systems in both normal and abnormal operation; and

d. Instruction in the differing intensities and forms of ice accretion and the consequent action which should be taken.

e. Instruction on how to land on wet and slush-covered slippery runways causing reduced braking efficiency, to avoid aquaplaning-induced runway far-end over-runs and rubber-reversion tyre damage.

12.2 For the Cabin Crew, the training should include;

a. Awareness of the conditions likely to produce aircraft surfaces contamination; and

b. The need to inform the Flight Crew of significant ice accretion and how to do this.

## 13. Aquaplaning
**(Extracts from a Skybary article by Eurocontrol)**

Aquaplaning – also known as hydroplaning – is a condition in which standing water causes the moving wheel of an aircraft to lose contact with the surface on which it is load bearing, with the result that braking action on the wheel is not effective in reducing the ground speed of the aircraft.

The continued incidence of aquaplaning reduces the braking co-efficient to that of an icy or "slippery" runway, which is less than 20% of that on a equivalent dry runway.

A layer of water builds up beneath the tyre in increasing resistance to displacement by the pressure of the wheel. Eventually, this results in the formation of a wedge between the runway and the tyre. This resistance to water displacement has a vertical component which progressively lifts the tyre and reduces the area in contact with the runway until the aircraft is completely water-borne. In this condition, the tyre is no longer capable of providing directional control or effective braking because the drag forces are so low. If such a runway surface state prevails, then flight crew are required to make their aircraft runway performance calculations using "slippery runway" data; this specifically allows for poor deceleration. They must also take account of crosswind component limits in the AFM which make allowance for less assured directional control.

Aquaplaning can occur when a wheel is running in the presence of water; it may also occur in certain circumstances when running in a combination of water and wet snow. Aquaplaning on runway surfaces with normal friction characteristics is unlikely to begin in water depths of 3mm or less. For this reason, a depth of 3mm has been adopted in Europe as the means to determine whether a runway surface is contaminated with water to the extent that aircraft performance assumptions are liable to be significantly affected. Once aquaplaning has commenced, it can be sustained over surfaces and in water depths which would not have led to its initiation.

In the case of the most common type of aquaplaning, called dynamic aquaplaning, a simple formula can calculate the minimum groundspeed for initiation of this type of aquaplaning on a sufficiently wet runway based upon tyre pressure. It is $\mathbf{V = 8.6 \times \sqrt{P}}$ (where groundspeed in knots = V and tyre inflation pressure in psi = P). This formula is based upon the validation of hydrodynamic lift theory by experimental evidence. The formula gives **M**inimum **I**nitiation **A**quaplane **S**peed (MIAS) i.e. aquaplaning may occur above this value, (133kts for a 747), and can continue below it.

### 13.1 Types of Aquaplaning

*Dynamic aquaplaning* is that which does not begin unless the tyre-pressure moderated ground speed as determined above is exceeded. It leaves no physical evidence on tyre or runway surface.

*Viscous aquaplaning* arises in the same way as dynamic aquaplaning, but only on abnormally smooth surfaces such as touchdown zones contaminated with excessive rubber deposits where it may begin and continue at any ground speed. Typically, a small amount of water may mix with a surface contaminant. It too leaves no physical evidence on tyre or runway surface.

*Reverted rubber aquaplaning* occurs when the heat of friction from a locked wheel in contact with the surface causes the reversion of the rubber to its un-cured state and 'boils' the surface moisture into steam. The pressure of the steam raises the centre of the tyre off the surface whilst the edges remain in contact, forming a seal which temporarily traps the steam. The tyre will show clear evidence of rubber reversion and the runway surface will be clearly marked with the path of the wheels as a result of ‘steam pressure cleaning’ beneath the tyre. This is the only type of ‘aquaplaning’ which leaves physical evidence on the runway surface. It was much more common before antiskid units became widespread and usually only occurs to aircraft so fitted if an emergency brake, which is applied directly rather than through the anti skid units, is used.

### 13.2 Runway Surface State

The surface state of a wet runway can be assessed by either:

- The depth of water in the touchdown zone, or
- The measured or observed braking action.

Standard terminology which describes a runway as dry, damp, wet, wet with water patches or flooded is in use is often found in association with the use of 3mm water depth over a significant part of the runway as the division between a normal runway and a contaminated one for aircraft performance purposes.

The best information a pilot is likely to get is prior to landing is an informal braking action comment made to ATC by a previously landed aircraft. This should be passed by ATC with the time of the report, the aircraft type which made it and any significant change in precipitation since it was received. Prior to takeoff, direct observation should enable the pilot to form a first hand impression of the surface state and the extent to which water is present on it. This will be particularly important in the event of a rejected take-off.

13.3 Avoiding Aquaplaning

If there is any doubt as to the probable extent of water of depth greater than 3mm on the landing runway, then an alternative runway should be chosen.

If the flight crew become aware, just before landing, that the depth of water on the runway has increased to an extent that the runway, especially in the touchdown zone, then a go-around should be flown. If this circumstance is not apparent until touchdown, then, provided it is permitted by the AFM, the landing should be promptly rejected from the runway.

A stabilised approach is required if it is decided that to continue an approach to a landing, so that the aircraft crosses the runway threshold at the correct airspeed and height, to achieve a touchdown within the TDZ. This is especially important when the landing distance required is close to the landing distance available.

13.4 General Airmanship Considerations

The pilot should be aware of the aquaplaning speed derived from the fully-inflated tyre pressure for both the maximum takeoff mass and maximum landing weight. Careful attention should be paid to the appearance of the tyres during the pre-flight external check, as far as possible, especially the depth of tread. Even though having the tyre pressure within allowable limits is important, it can be extremely difficult to assess this visually on multi-wheel landing gear.

The main gear touchdown on a wet runway should always be firm and made without any bounce in order to break through the surface water film and make effective contact with the runway surface.

13.5 Braking, Spoiler Deployment, Thrust Reversers and Control Column Handling

Once touchdown on all of the landing gear has been achieved and sustained, SOPs usually recommend application of positive forward control column pressure in order to reduce the wing incidence and therefore lift, to assist in imposing the full aircraft weight onto the landing gear.

A significant crosswind component may result in a difference between the amount of weight transferred onto each main gear assembly. This is because, even with the wings being held level by into-wind aileron, fuselage shielding partly blanks the downwind wing. This increases the likelihood of difficulties with directional control in a situation where the possibility of transient differential aquaplaning may also exist.

Full reverse thrust or reverse pitch should be selected whilst the ground speed is still high in order to gain maximum effect, if available. Full ground spoiler deployment should also be made as soon as all wheels are on the ground if manual selection is necessary. Auto deployment of ground spoilers may be delayed until a specific wheel rotational speed, perhaps 25 kts, is sensed. Brake Units are likely to have anti skid systems fitted so that any applied brake pressure by-passes the units until a specified wheel rotational speed is reached after touchdown. Typically, this could be 50 kts. Auto braking selection should follow AFM requirements and Operator SOPs; manual braking may be inhibited until a specific time after the final touchdown is sensed. It is important to understand how each of these contributions to deceleration work so that if aquaplaning should occur, it is recognised as such rather than mistaken for a system malfunction.

13.6 Recovery from Aquaplaning

Aquaplaning should be avoided if at all possible because, once it has started, there is no certain way of regaining control and establishing useful deceleration.

In the case of continued aquaplaning, deceleration can be expected to correspond to that for a slippery runway with braking coefficient of around 0.05. Around 50% more stopping distance will be needed if thrust reversers are not available and around 25% if they are (since account is not taken of their effect for normal landing performance calculations).

Prior to attempting a landing on a runway where aquaplaning is likely, check that sufficient 'slippery runway' landing distance exists so that a runway excursion will not follow if aquaplaning commences.

If there is a significant crosswind component, a landing on a potentially slippery runway should not be attempted. AFM limitations usually impose specific restrictions on allowable crosswind component for this case.

Apart from an immediate rejected landing where AFM limitations and Operator SOPs allow it, there is little that can be done if aquaplaning begins and continues. If manual braking is being used, then briefly releasing and then reapplying pressure may succeed in increasing braking effectiveness. However, under no circumstances (except gross malfunction) should anti skid be disabled since hard braking on a wet runway without this protection is certain to lead to reverted rubber aquaplaning and a decrease in deceleration due to locked wheels.

**ADDITIONAL USEFUL INFORMATION ON WINTER OPERATIONS IN SNOW, SLUSH AND ICING CONDITIONS**

In FODCOM 33/2008, Sub-section 6, captioned ***Further Information,*** the following entries help to provide reference material for de-icing/anti-icing training courses:-

6.1. The Winter Operations section contained within the Flight Operations part of the CAA website (under Types of Operation) is a source of more information.

6.2 EASA training material is available via the Winter Operations section of the CAA website.

6.3. Several FODCOMS, including 15/2006, 19/2006, and 36/2007, provide guidance for Winter Operations.

6.4. Notice to Aerodrome Licence Holders (NOTAL) 9/2006, captioned Winter Operations, also contains information and advice on contaminated runways and can be found on the CAA website.

6.5. AIC 118/2006 (Pink 106), provides recommendations for de-icing/anti-icing of aircraft on the ground.

6.6. The Association of European Airlines (AEA) is one of several organisations that provide guidance material. Their manuals, '*Recommendations for de-icing / anti-icing of Aircraft on the Ground'* and *Background information for de-icing /anti-icing on the Ground* are available via the website: www.aea.be.

The CAA website (www.caa.co.uk) also contains the following applicable information:-

**Notices to Aerodrome Licence Holders (NOTAL)**

NOTAL 2008/11 contains the following text which further expands FODCOM 31/2008 guidance.

**Civil Air Publications (CAP)**

**CAP 168**

1. **Appendix 3D:** National Snow Plan, including procedures for dealing with winter contamination of aerodrome surfaces.
2. **Appendix 3G:** Care of pavements during Winter Conditions - Improving surface friction by removal of contaminants.
3. **Chapter 10:** Aeronautical Information.

**CAP 728** The Management of Safety: Guidance to Aerodromes and Air Traffic Service Units on the Development of Safety Management Systems.

**CAP 493** Manual of Air Traffic Procedures - Part 1, Chapter 8. This is about Snow and Ice as it applies to an ATCO, but is interesting. In addition, the following information is available.

**Flight Operations Department Communications (FODCOM)**

FODCOM 31/2008 - Training for Ground De-icing and Anti-icing of Aircraft.

FODCOM 33/2008 - Winter Operations.

**Aeronautical Information Circulars (AIC)**

**AIC 86/2007 (Pink 126)** - Risks and Factors associated with Operations on runways contaminated by snow, slush or water.

**AIC 93/2007 (Yellow 247)** - Guidance for the Distribution & Completion of SNOWTAM Form (CA 1272).

**AIC 118/2006 (Pink 106)** - De-icing of Aircraft on the Ground, Recommendations for.

**UK AIP**

Licence holders' attention is also drawn to the UK AIP section AD 1.2.2, and particularly paragraphs 5.4 and 5.5, for guidance on the assessment and notification of a runway that is contaminated by slush or uncompacted snow. In addition, the following information is also available:

**TRAINING MATERIAL**

The CAA has created a Winter Operations training package. The CD/DVD is available free of charge from your Regional Office. Two web-based training packages produced by the NASA GRC icing branch are available:

- **A Pilot's Guide to In-flight Icing**
- **A Pilot's Guide to Ground Icing**

A web-based course to provide pilots with a way to help them avoid the hazards of ice contamination while their aircraft are on the ground has been launched by an international team of safety experts, including the UK Civil Aviation Authority (CAA).

The 'Pilot's Guide to Ground Icing' is a free online course intended primarily for professional pilots who make their own de-icing and anti-icing decisions. The self-guided course provides pilots with general ground icing knowledge, an understanding of freezing precipitation hazards and the ability to improve decision-making in ground icing operations.

It discusses the risks of contamination, provides cues to alert the pilot to ground icing conditions and offers actions that pilots can take to help ensure safe operations. Imagery, case studies, pilot testimonials and interactive elements are used to inform and help pilots make better operational decisions.

Ground icing accidents are often preventable and by providing pilots with the online training course, we hope to improve the safety of their flights.

An international team led by NASA researchers developed the new educational tool. The team included experts from NASA's Ames and Glenn Research Centres; UK CAA; US Federal Aviation Administration; Transport Canada; Canadian Armed Forces; the University of Oregon; a fractional jet provider and an airline.

'***A Pilot's Guide to Ground Icing'*** and '***A Pilot's Guide to In-flight Icing'*** courses are both available on the web, at: **http://aircrafticing.grc.nasa.gov/courses.html**

[Highlight link then press CTRL + Left click mouse or 'Return' to reach the web site]

The CAA has also re-released its Ice Aware DVD, which is also aimed at pilots and covers issues surrounding aircraft icing. Copies are available free of charge from Alison Jarvis email **alison.jarvis@srg.caa.co.uk.**

For more information, please contact CAA on +44 (0) 20 7453 6027

De-icing in progress …




**END OF APPENDIX C – WINTER OPERATIONS**

## APPENDIX D - MANDATORY OCCURRENCE REPORTING (MOR) SCHEME

**Example of a Company Operations Manual Reference on the matter of reporting incidents and accidents.**

**TABLE OF REPORTABLE OCCURRENCES**

EXAMPLES OF WHEN A MANDATORY OCCURRENCE REPORT (MOR) **MUST** BE COMPLETED

The guidance below shows examples of when a Mandatory Occurrence Report (MOR) **must** be completed by the Captain. Where indicated, a Company Safety Report (CSR) may be more appropriate for other Irregularities or Cabin Safety matters. However, the list is not exhaustive and serves only as a guide. If in doubt, seek further guidance from the Company Flight Safety Department before submitting a CSR instead of the otherwise Mandatory MOR.

| | |
|---|---|
| AIRCRAFT DAMAGE | Any damage on the ground or in the air; loss of part of structure |
| AIRCRAFT DOCUMENTATION | **Irregularity Report**: *Unless flight safety critical* |
| APPROACH PLATES / CHARTS | **Irregularity Report**: Incorrect charts or plates *unless flight safety critical* |
| ATC | Loss of communication, AIRPROX or ATC deficiency |
| | Near collision: aircraft, vehicle, equipment, person or object |
| BIRDSTRIKE | Any |
| COMMUNICATIONS | Loss of communication; Call-sign confusion; Aircraft internal communications |
| CONTROL DIFFICULTIES | Any; Primary system failure; Alternate Law, Direct Law |
| CREW INCAPACITATION | Injury/sickness pre, during flight;<br>**Cabin crew:** unable to perform EMERGENCY duties |
| DANGEROUS GOODS | Any incident, spillage, mislabelling or NOTOC errors |
| DEPRESSURISATION | Any |
| EMERGENCY CALL | PAN or MAYDAY |
| EMERGENCY CHECKLIST | Any |
| EMERGENCY EVACUATION | Any |
| EMERGENCY LANDING | Any |
| ENGINE | Flameout, shutdown, malfunction; Overspeed of APU, ACM, ATM or air starter |
| | Uncontrolled internal / external fire, hot gas leak; Engine limit exceedance; FOD |
| | Thrust in a direction other than demanded by pilot; Thrust reverser failure or inadvertent operation; Uncommanded thrust / power loss |
| FIRE & SMOKE | Any |
| FLAP LIMIT EXCEEDANCE | Any |
| FUEL | Low; Transfer problems; Imbalance limits exceeded |
| GO-AROUND | Producing a hazardous or potentially hazardous situation |
| EGPWS / GPWS | Any |
| HUMAN FACTORS | CRM breakdown; A feature or inadequacy of aircraft design that could lead to an error or contribute to a hazardous or catastrophic effect;<br>Incorrect setting of SSR or Altimeter sub-scale |
| ICING (IN-FLIGHT) | Resulting in handling difficulties, damage to aircraft, loss or malfunction of any essential service |
| LANDING | Precautionary or forced landing |
| | Undershooting, overrunning or running off the side of runways |
| | Landings or attempted landings on closed, occupied or incorrect runway |
| | Descent below DH / DA or MDH / MDA without required visual references |
| LEVEL BUST | Plus or Minus 300 feet excursion (note maximum excursion) |
| LIGHTNING STRIKE | Which results in Loss or Malfunction of essential equipment |
| LOADING | Non SOP, incorrect load sheet, tail-tip |
| MEDICAL | Diversion;<br>**Company Safety Report (CSR):** *'Medlink'* contact, doctor's kit use, passenger injury/illness, death on board |
| NAVIGATIONAL ERROR | Gross; ETOPS; Incorrect route flown |
| PASSENGERS | Bomb threat; Hijack; Stowaway; Level 2 disruptive, intoxicated, violent or unruly |
| | Incorrect loading (Mass & Balance) |
| RUNWAY | Incursion, excursion, undershoot, overrun, tail-strike |

| | |
|---|---|
| SECURITY | Aircraft security breach, level 2 disruptive pax, bomb warning, intercept |
| SYSTEMS | Loss; Malfunction; Defect; Uncommanded Actions; Runaway; Failure; Interference between systems; Leak resulting in fire hazard; Failure at critical phase of flight; Shortfall of performance; Asymmetry of controls |
| STALL WARNING | Any operation of primary warning system associated with manoeuvring the aircraft: Configuration warning, Stall warning, Overspeed warning etc |
| TAKEOFF | Tail-strike, no take-off clearance; Rejected take-off (note speed) |
| | Overrunning or running off the side of runways |
| | Take-off or attempted take-off on closed, occupied or incorrect runway |
| TCAS | Resolution Advisories (RAs) |
| TURBULENCE | Severe |
| TYRE BURST | Any |
| WAKE TURBULENCE | Any |
| WINDSHEAR | Any |

Further information may be found in CAA CAP 382 - The Mandatory Occurrence Reporting Scheme
It may be downloaded in PDF format from the UK CAA Web site: [www.caa.co.uk](http://www.caa.co.uk)

**Reportable incident …**


© Captain Philip 'Phil' H S SMITH MRAeS

**END OF APPENDIX D – MOR TABLE**

## APPENDIX E – EU-OPS 1 - SUB PART E – ALL WEATHER OPERATIONS & AERODROME OPERATING MINIMA

This Appendix contains the underpinning EASA Legislation upon which Aerodrome Operating Minima (AOM) calculations are based. It also introduces the necessary EASA requirements for All Weather Operations (AWO or AWOPS).

The Appendix outlines Airport Requirements for Low Visibility Operations (LVO), another term for AWO/AWOPS. The Rules are particular to the application of AOM and on how pilots are to operate within them. If necessary, pilots may calculate appropriate AOM using the given limiting parameters. Proprietary Flight Guides such as those produced by Jeppesen & Thales/Aerad and other similar providers usually contain a Chapter that deals with said calculations. The subject is covered here nonetheless, for ease of reference. It will be noted that AOM limitations are not only applicable to UK Commercial Air Transport operations, but they are also applicable to all other aircraft, including non-UK registered aircraft operated into and out of UK aerodromes. State Minima that override any self-calculated AOM apply in some Countries such as the USA and France.

**CONTENTS - EU-OPS 1 - SUB PART E - ALL WEATHER OPERATIONS (& AERODROME OPERATING MINIMA (AOM))**

(d) Data analysis
(e) Continuous monitoring
(f) Transitional periods
(g) Maintenance of Category II, Category III and LVTO equipment.
(h) Eligible aerodromes and runways

6. **OPS 1.450 - Low Visibility Operations — Training and Qualifications**
**See EASA core documentation & The AWOPS Guide, published in autumn 2010**

7. **APPENDIX 1 to OPS 1.455 - Low Visibility Operations — Operating Procedures**
(a) General
(b) Procedures and operating instructions

8. **APPENDIX 1 to OPS 1.465 - Minimum Visibilities for VFR Operations**

9. **Instrument Approaches - Aerodrome Operating Minima (AOM) Summary**

**Extracts are from the current EASA OPS 1 - SUB PART E *'ALL WEATHER OPERATIONS'***
**(OPS 1.430 Aerodrome Operating Minima (AOM) and Appendices (Old & New) to OPS 1.1430)**

## 1. GENERAL

### 1.1 OPS 1.430 - AERODROME OPERATING MINIMA — GENERAL (See Appendix 1 Old & New to OPS 1.430)

(a)1. An operator shall establish, for each aerodrome planned to be used, aerodrome operating minima that are not lower than the values given in Appendix 1 (Old) or Appendix 1 (New) as applicable. The method of determination of such minima must be acceptable to the Authority. Such minima shall not be lower than any that may be established for such aerodromes by the State in which the aerodrome is located, except when specifically approved by that State. The use of HUD, HUDLS or EVS may allow operations with lower visibilities than normally associated with the aerodrome operating minima. States which promulgate aerodrome operating minima may also promulgate regulations for reduced visibility minima associated with the use of HUD or EVS.

(a)2 Notwithstanding paragraph (a)1 above, in-flight calculation of minima for use at unplanned alternate aerodromes and/or for approaches utilising EVS shall be carried out in accordance with a method acceptable to the Authority.

(b) In establishing the aerodrome operating minima which will apply to any particular operation, an operator must take full account of:
1. The type, performance and handling characteristics of the aeroplane;
2. The composition of the flight crew, their competence and experience;
3. The dimensions and characteristics of the runways which may be selected for use;
4. The adequacy and performance of the available visual and non-visual ground aids; (See Appendix 1 (New) to OPS 1.430 Table 6a);
5. The equipment available on the aeroplane for the purpose of navigation and/or control of the flight path, as appropriate, during the take-off, the approach, the flare, the landing, roll-out and the missed approach;
6. The obstacles in the approach, missed approach and the climb-out areas required for the execution of contingency procedures and necessary clearance;
7. The obstacle clearance altitude/height for the instrument approach procedures;
8. The means to determine and report meteorological conditions; and
9. The flight technique to be used during the final approach.

(c) The aeroplane categories referred to in this Subpart must be derived in accordance with the method given in Appendix 2 to OPS 1.430 (c).

(d)1 All approaches shall be flown as stabilised approaches (SAp), unless otherwise approved by the Authority for a particular approach to a particular runway.

(d)2 All non-precision approaches shall be flown using the continuous descent final approaches (CDFA) technique, unless otherwise approved by the Authority for a particular approach to a particular runway. When calculating the minima in accordance with Appendix 1 (New), the operator shall ensure that the applicable minimum RVR is increased by 200 metres (m) for Cat A/B aeroplanes and by 400 m for Cat C/D aeroplanes for approaches not flown using the CDFA technique, providing that the resulting RVR/CMV value does not exceed 5,000 m.

(d)3 Notwithstanding the requirements in (d)2 above, an Authority may exempt an operator from the requirement to increase the RVR when not applying the CDFA technique.

(d)4 Exemptions as described in paragraph (d)3 must be limited to locations where there is a clear public interest to maintain current operations. The exemptions must be based on the operator's experience, training programme and flight crew qualification. The exemptions must be reviewed at regular intervals and must be terminated as soon as facilities are improved to allow application of the CDFA technique.

(e)1 **An operator must ensure that either Appendix 1 (Old) or Appendix 1 (New) to OPS 1.430 is applied. However, an operator must ensure that Appendix 1 (New) to OPS 1.430 is applied not later than three years after publication date.**

(e)2 **Notwithstanding the requirements in (e)1. above, an Authority may exempt an operator from the requirement to increase the RVR above 1 500 m (Cat A/B aeroplanes) or above 2 400 m (Cat C/D aeroplanes), when approving an operation to a particular runway where it is not practicable to fly an approach using the CDFA technique or where the criteria in paragraph (c) of Appendix 1 (New) to OPS 1.430 cannot be met.**

(e)3 Exemptions as described in paragraph (e)2 must be limited to locations where there is a clear public interest to maintain current operations. The exemptions must be based on the operator's experience, training programme and flight crew qualification. The exemptions must be reviewed at regular intervals and must be terminated as soon as facilities are improved to allow application of the CDFA technique.

### 1.2 OPS 1.435 - TERMINOLOGY

(a) Terms used in this Subpart have the following meaning:

1. **Circling:** The visual phase of an instrument approach to bring an aircraft into position for landing on a runway which is not suitably located for a straight-in approach.
2. **Low Visibility Procedures (LVP):** Procedures applied at an aerodrome for the purpose of ensuring safe operations during Lower than Standard Category I, Other than Standard Category II, Category II and III approaches and low visibility take-offs.
3. **Low Visibility Take-Off (LVTO):** A take-off where the Runway Visual Range (RVR) is less than 400m.
4. **Flight control system:** A system which includes an automatic landing system and/or a hybrid landing system.
5. **Fail-Passive flight control system:** A flight control system is fail-passive if, in the event of a failure, there is no significant out-of-trim condition or deviation of flight path or attitude but the landing is not completed automatically. For a fail-passive automatic flight control system the pilot assumes control of the aeroplane after a failure.
6. **Fail-Operational flight control system:** A flight control system is fail-operational if, in the event of a failure below alert height, the approach, flare and landing, can be completed automatically. In the event of a failure, the automatic landing system will operate as a fail-passive system.
7. **Fail-Operational hybrid landing system:** A system which consists of a primary fail-passive automatic landing system and a secondary independent guidance system enabling the pilot to complete a landing manually after failure of the primary system.

   *Note:* A typical secondary independent guidance system consists of a monitored head-up display providing guidance which normally takes the form of command information but it may alternatively be situation (or deviation) information.
8. **Visual Approach**: An approach when either part or all of an instrument approach procedure is not completed and the approach is executed with visual reference to the terrain.
9. **Continuous descent final approach (CDFA):** A specific technique for flying the final-approach segment of a non-precision instrument approach procedure as a continuous descent, without level-off, from an altitude/height at or above the Final Approach Fix altitude / height to a point approximately 15 m (50 feet) above the landing runway threshold or the point where the flare manoeuvre should begin for the type of aeroplane flown.
10. **Stabilised approach (SAp**): An approach which is flown in a controlled and appropriate manner in terms of configuration, energy and control of the flight path from a pre-determined point or altitude/height down to a point 50 feet above the threshold or the point where the flare manoeuvre is initiated if higher.
11. **Head-up display (HUD):** A display system which presents flight information into the pilot's forward external field of view and which does not significantly restrict the external view.
12. **Head-up guidance landing system (HUDLS):** The total airborne system which provides head-up guidance to the pilot during the approach and landing and/or go-around. It includes all sensors, computers, power supplies, indications and controls. A HUDLS is typically used for primary **approach guidance to decision heights of 50 ft.**
13. **Hybrid head-up display landing system (hybrid HUDLS):** A system which consists of a primary fail-passive automatic landing system and a secondary independent HUD/HUDLS enabling the pilot to complete a landing manually after failure of the primary system.

*Note:* Typically, the secondary independent HUD/HUDLS provides guidance which normally takes the form of command information, but it may alternatively be situation (or deviation) information.

14. **Enhanced vision system (EVS):** An electronic means of displaying a real-time image of the external scene, through the use of imaging sensors.
15. **Converted meteorological visibility (CMV):** A value (equivalent to an RVR) which is derived from the reported meteorological visibility, as converted in accordance with the requirements in this subpart.
16. **Lower than Standard Category I Operation:** A Category I Instrument Approach and Landing Operation using Category I DH, with an RVR lower than would normally be associated with the applicable DH.
17. **Other than Standard Category II Operation:** A Category II Instrument Approach and Landing Operation to a runway where some or all of the elements of the ICAO Annex 14 Precision Approach Category II lighting system are not available.
18. **GNSS landing system (GLS):** An approach operation using augmented GNSS information to provide guidance to the aircraft based on its lateral and vertical GNSS position. (It uses geometric altitude reference for its final approach slope).

### 1.3 OPS 1.440 - LOW VISIBILITY OPERATIONS - GENERAL OPERATING RULES (See Appendix 1 to 1.440)

(a) An operator shall not conduct Category II or III operations unless:

1. Each aeroplane concerned is certificated for operations with decision heights below 200 ft, or no decision height, and equipped in accordance with CS-AWO on all weather operations or an equivalent accepted by the Authority;
2. A suitable system for recording approach and/or automatic landing success and failure is established and maintained to monitor the overall safety of the operation;
3. The operations are approved by the Authority;
4. The flight crew consists of at least 2 pilots; and
5. Decision Height is determined by means of a radio altimeter.

(b) **An operator shall not conduct low visibility take-offs in less than 150 m RVR (Category A, B and C aeroplanes) or 200 m RVR (Category D aeroplanes) unless approved by the Authority.**

(**c**) An operator shall not conduct lower than Standard Category I operations unless approved by the Authority.

### 1.4 OPS 1.445 - LOW VISIBILITY OPERATIONS — AERODROME CONSIDERATIONS

(a) An operator shall not use an aerodrome for Category II or III operations unless the aerodrome is approved for such operations by the State in which the aerodrome is located.

(b) An operator shall verify that Low Visibility Procedures (LVP) have been established, and will be enforced, at those aerodromes where low visibility operations are to be conducted.

### 1.5 OPS 1.450 - LOW VISIBILITY OPERATIONS - TRAINING AND QUALIFICATIONS (See Appendix 1 to OPS 1.450)

An operator shall ensure that, prior to conducting low visibility take-off lower than Standard Category I, other than Standard Category II, Category II and III operations or approaches utilising EVS:

(a) 1. Each flight crew member:
   - (i) Completes the training and checking requirements prescribed in Appendix 1, including Flight simulator training in operating to the limiting values of RVR/CMV and Decision Height appropriate to the operator's approval; and
   - (ii) Is qualified in accordance with Appendix 1;

2. The training and checking is conducted in accordance with a detailed syllabus approved by the Authority and included in the Operations Manual. This training is in addition to that prescribed in Subpart N; and

3. The flight crew qualification is specific to the operation and the aeroplane type.

### 1.6 OPS 1.455 - LOW VISIBILITY OPERATIONS — OPERATING PROCEDURES (See Appendix 1 to OPS 1.455)

(a) An operator must establish procedures and instructions to be used for low visibility take-off, approaches utilising EVS, Lower than Standard Category I, other than Standard Category II, Category II and III operations. These procedures must be included in the Operations Manual and contain the duties of flight crew members during taxiing, take-off, approach, flare, landing, roll-out and missed approach as appropriate.

(b) The commander shall satisfy himself/herself that:

1. The status of the visual and non-visual facilities is sufficient prior to commencing a low visibility take-off, an approach utilising EVS, a lower than Standard Category I, an other than Standard Category II, or a Category II or III approach;
2. Appropriate LVPs are in force according to information received from Air Traffic Services, before commencing a low visibility take-off, a lower than Standard Category I, an other than Standard Category II, or a Category II or III approach; and
3. The flight crew members are properly qualified prior to commencing a low visibility take-off in an RVR of less than 150 m (Category A, B and C aeroplanes) or 200 m (Cat D aeroplanes), an approach utilising EVS, a lower than Standard Category I, an other than Standard Category II or a Category II or III approach.

**1.7 OPS 1.460 - LOW VISIBILITY OPERATIONS — MINIMUM EQUIPMENT**

(a) An operator must include in the Operations Manual the minimum equipment that has to be serviceable at the commencement of a low visibility take-off, or a lower than Standard Category I approach, or an other than Standard Category II approach, or an approach utilising EVS, or a Category II or III approach, in accordance with the AFM or other approved document.

(b) The commander shall satisfy himself/herself that the status of the aeroplane and of the relevant airborne systems is appropriate for the specific operation to be conducted.

**1.8 OPS 1.465 - VFR OPERATING MINIMA** (See Appendix 1 to OPS 1.465)

(a) An operator shall ensure that:

1. VFR flights are conducted in accordance with the Visual Flight Rules and in accordance with the Table in Appendix 1 to OPS 1.465.
2. Special VFR flights are not commenced when the visibility is less than 3 km and not otherwise conducted when the visibility is less than 1.5 km.

**2. APPENDIX 1 (Old) to OPS 1.430 - AERODROME OPERATING MINIMA**

**(a) Take-off Minima**

1. **General**

(i) Take-off minima established by the operator must be expressed as visibility or RVR limits, taking into account all relevant factors for each aerodrome planned to be used and the aeroplane characteristics. Where there is a specific need to see and avoid obstacles on departure and/or for a forced landing, additional conditions (e.g. ceiling) must be specified.

(ii) The commander shall not commence take-off unless the weather conditions at the aerodrome of departure are equal to or better than applicable minima for landing at that aerodrome, unless a suitable take-off alternate aerodrome is available.

(iii) When the reported meteorological visibility is below that required for take-off and RVR is not reported, a take-off may only be commenced if the commander can determine that the RVR/visibility along the take-off runway is equal to or better than the required minimum.

(iv) When no reported meteorological visibility or RVR is available, a take-off may only be commenced if the commander can determine that the RVR/visibility along the take-off runway is equal to or better than the required minimum.

2. **Visual reference**. The take-off minima must be selected to ensure sufficient guidance to control the aeroplane in the event of both a discontinued take-off in adverse circumstances and a continued take-off after failure of the critical power unit.

3. **Required RVR/Visibility**

(i) For multi-engine aeroplanes, whose performance is such that, in the event of a critical power unit failure at any point during take-off, the aeroplane can either stop or continue the take-off to a height of 1,500 ft above the aerodrome while clearing obstacles by the required margins, the take-off minima established by an operator must be expressed as RVR/Visibility values not lower than those given in Table 1 below, except as provided in paragraph (4) below:

**Table 1 – RVR / Visibility for take-off**

| Take-off RVR / Visibility | |
|---|---|
| **Facilities** | **RVR/Visibility (See *Note 3*)** |
| Nil (Day only) | 500 m |

| | |
|---|---|
| Runway edge lighting and/or centreline marking | 250/300 m (*Notes 1 and 2*) |
| Runway edge & centreline lights | 200/250 m (*Note 1*) |
| Runway edge and centreline lighting + multiple RVR readings | 150/200 m (*Notes 1 and 4*) |

*Note 1:* The higher values apply to Category D aeroplanes.

*Note 2:* For night operations at least runway edge and runway end lights are required.

*Note 3:* The reported RVR/Visibility value representative of the initial part of the take-off run can be replaced by pilot assessment.

*Note 4:* The required RVR value must be achieved for all of the relevant RVR reporting points with the exception given in Note 3 above.

multi

| **Comparable Values of RVR & Ground Visibility** | | |
|---|---|---|
| **RVR Feet** | **Visibility Statute Miles** | **Equivalent RVR Meters** |
| 1600 | 1/4 | 500 |
| 2000 | 3/8 | 600 |
| 2400 | 1/2 | 700 |
| 3200 | 5/8 | 950 |
| 4000 | 3/4 | 1,200 |
| 4500 | 7/8 | 1,350 |
| 5000 | 1 | 1,500 |
| 6000 | 1¼ | 2,000 |

(ii) For multi -engine aeroplanes whose performance is such that they cannot comply with the performance conditions in subparagraph (a)(3)(i) above in the event of a critical power unit failure, there may be a need to re-land immediately and to see and avoid obstacles in the take-off area. Such aeroplanes may be operated to the following take-off minima, provided they are able to comply with the applicable obstacle clearance criteria, assuming engine failure at the height specified. The take-off minima established by an operator must be based upon the height from which the one engine inoperative net take-off flight path can be constructed. The RVR minima used may not be lower than either of the values given in Table 1 above or Table 2 below.

**Table 2 - Assumed engine failure height above the runway versus RVR/Visibility**

| **Take-off RVR/Visibility — Flight path** | |
|---|---|
| **Assumed engine failure height above the take-off runway** | **RVR/Visibility (*Note 2*)** |
| < 50 ft | 200 m |
| 51-100 ft | 300 m |
| 101-150 ft | 400 m |
| 151-200 ft | 500 m |
| 201-300 ft | 1,000 m |
| > 300 ft | 1,500 m (*Note 1*) |

*Note 1:* 1,500 m is also applicable if no positive take-off flight path can be constructed.

*Note 2:* The reported RVR/Visibility value representative of the initial part of the take-off run can be replaced by pilot assessment.

(iii) When reported RVR, or meteorological visibility is not available, the commander shall not commence take-off unless he/she can determine that the actual conditions satisfy the applicable take-off minima.

4. **Exceptions to paragraph (a)(3)(i) above:**

(i) Subject to the approval of the Authority and provided the requirements in sub-headings (A) to (E) below have been satisfied, an operator may reduce the take-off minima to 125 m RVR (Category A, B and C aeroplanes) or 150 m RVR (Category D aeroplanes) when:

(A) Low Visibility Procedures are in force;

(B) High intensity runway centreline lights spaced 15 m or less and high intensity edge lights spaced 60 m or less are in operation;

(C) Flight crew members have satisfactorily completed training in a Flight Simulator;

(D) A 90 m visual segment is available from the cockpit at the start of the take-off run; and

(E) The required RVR value has been achieved for all of the relevant RVR reporting points.

(ii) Subject to the approval of the Authority, an operator of an aeroplane using an approved lateral guidance system for take-off may reduce the take-off minima to an RVR less than 125 m (Category A, B and C aeroplanes) or 150 m (Category D aeroplanes) but not lower than 75 m, provided runway protection and facilities equivalent to Category III landing operations are available.

(b) **Non-Precision Approach**

1. **System minima**

(i) An operator must ensure that system minima for non-precision approach procedures, which are based upon the use of ILS without glide path (LLZ only), VOR, NDB, SRA and VDF are not lower than the MDH values given in Table 3 below.

**Table 3 - System minima for non-precision approach aids**

| System minima | |
|---|---|
| **Facility** | **Lowest MDH** |
| ILS (no glide path — LLZ) | 250 ft |
| SRA (terminating at 1/2 NM) | 250 ft |
| SRA (terminating at 1 NM) | 300 ft |
| SRA (terminating at 2 NM) | 350 ft |
| VOR | 300 ft |
| VOR/DME | 250 ft |
| NDB | 300 ft |
| VDF (QDM & QGH) | 300 ft |

2. **Minimum Descent Height**.

An operator must ensure that the minimum descent height for a non-precision approach is not lower than either:

(i) The OCH/OCL for the category of aeroplane; or

(ii) The system minimum.

3. **Visual Reference.**

A pilot may not continue an approach below MDA/MDH unless at least one of the following visual references for the intended runway is distinctly visible and identifiable to the pilot:

(i) Elements of the approach light system;

(ii) The threshold;

(iii) The threshold markings;

(iv) The threshold lights;

(v) The threshold identification lights;

(vi) The visual glide slope indicator;

(vii) The touchdown zone or touchdown zone markings;

(viii) The touchdown zone lights;

(ix) Runway edge lights; or

(x) Other visual references accepted by the Authority.

4. **Required RVR.** The lowest minima to be used by an operator for non-precision approaches are:

**Table 4a - RVR for non-precision approach — full facilities**

| Non-precision approach minima<br>Full facilities (*Notes (1), (5), (6) and (7)*) | | | | |
|---|---|---|---|---|
| **MDH** | **RVR/Aeroplane Category** | | | |
| | **A** | **B** | **C** | **D** |
| 250-299 ft | 800 m | 800 m | 800 m | 1 200 m |
| 300-449 ft | 900 m | 1,000 m | 1,000 m | 1,400 m |
| 450-649 ft | 1,000 m | 1,200 m | 1,200 m | 1,600 m |
| 650 ft and above | 1,200 m | 1,400 m | 1,400 m | 1,800 m |

**Table 4 b- RVR for non-precision approach — intermediate facilities**

| Non-precision approach minima<br>Intermediate facilities (*Notes (2), (5), (6) and (7)*) | | | | |
|---|---|---|---|---|
| **MDH** | **RVR/Aeroplane Category** | | | |
| | **A** | **B** | **C** | **D** |
| 250-299 ft | 1,000 m | 1,100 m | 1,200 m | 1,400 m |
| 300-449 ft | 1,200 m | 1,300 m | 1,400 m | 1,600 m |
| 450-649 ft | 1,400 m | 1,500 m | 1,600 m | 1,800 m |
| 650 ft and above | 1,500 m | 1,500 m | 1,800 m | 2,000 m |

**Table 4c - RVR for non-precision approach — basic facilities**

| Non-precision approach minima<br>Basic facilities (*Notes (3), (5), (6) and (7)*) | | | | |
|---|---|---|---|---|
| **MDH** | **RVR/Aeroplane Category** | | | |
| | **A** | **B** | **C** | **D** |
| 250-299 ft | 1,200 m | 1,300 m | 1,400 m | 1,600 m |
| 300-449 ft | 1,300 m | 1,400 m | 1,600 m | 1,800 m |
| 450-649 ft | 1,500 m | 1 500 m | 1 800 m | 2,000 m |
| 650 ft and above | 1,500 m | 1,500 m | 2,000 m | 2,000 m |

**Table 4d - RVR for non-precision approach — Nil approach light facilities**

| Non-precision approach minima<br>Nil approach light facilities (*Notes (4), (5), (6) and (7)*) | | | | |
|---|---|---|---|---|
| **MDH** | **RVR/Aeroplane Category** | | | |
| | **A** | **B** | **C** | **D** |
| 250-299 ft | 1,500 m | 1,500 m | 1,600 m | 1,800 m |
| 300-449 ft | 1,500 m | 1,500 m | 1,800 m | 2,000 m |
| 450-649 ft | 1,500 m | 1,500 m | 2,000 m | 2,000 m |
| 650 ft and above | 1,500 m | 1,500 m | 2,000 m | 2,000 m |

*Note 1:* Full facilities comprise runway markings, 720 m or more of HI/MI approach lights, runway edge lights, threshold lights and runway end lights. Lights must be on.

*Note 2:* Intermediate facilities comprise runway markings, 420-719 m of HI/MI approach lights, runway edge lights, threshold lights and runway end lights. Lights must be on.

*Note 3:* Basic facilities comprise runway markings, <420 m of HI/MI approach lights, any length of LI approach lights, runway edge lights, threshold lights and runway end lights. Lights must be on.

*Note 4:* Nil approach light facilities comprise runway markings, runway edge lights, threshold lights, runway end lights, or no lights at all.

*Note 5:* The tables are only applicable to conventional approaches with a nominal descent slope of not greater than 4°. Greater descent slopes will usually require that visual glide slope guidance (e.g. PAPI) is also visible at the Minimum Descent Height.

*Note 6:* The above figures are either reported RVR or meteorological visibility converted to RVR, as in subparagraph (h) below.

*Note 7:* The MDH mentioned in Table 4a, 4b, 4c and 4d refers to the initial calculation of MDH. When selecting the associated RVR, there is no need to take account of a rounding up to the nearest ten feet, which may be done for operational purposes, e.g. conversion to MDA.

**5.** **Night operations.** For night operations at least runway edge, threshold & runway end lights must be on.

(c) **Precision Approach — Category I Operations**

1. **General.** A Category I operation is a precision instrument approach and landing using ILS, MLS or PAR with a decision height not lower than 200 ft and with a runway visual range not less than 550 m.

2. **Decision Height:** An operator must ensure that the decision height to be used for a Category I precision approach is not lower than:
   (i) The minimum decision height specified in the Aeroplane Flight Manual (AFM) if stated;
   (ii) The minimum height to which the precision approach aid can be used without the required visual reference;
   (iii) The OCH/OCL for the category of aeroplane; or
   (iv) 200 ft.

3. **Visual Reference.** A pilot may not continue an approach below the Category I decision height, determined in accordance with subparagraph (c)(2) above, unless at least one of the following visual references for the intended runway is distinctly visible and identifiable to the pilot:
   (i) Elements of the approach light system;
   (ii) The threshold;
   (iii) The threshold markings;
   (iv) The threshold lights;
   (v) The threshold identification lights;
   (vi) The visual glide slope indicator;
   (vii) The touchdown zone or touchdown zone markings;
   (viii) The touchdown zone lights; or
   (ix) Runway edge lights.

4. **Required RVR.** The lowest minima to be used by an operator for Category I operations are:

**Table 5 - RVR for Cat I approach v/s facilities and DH**

| **Category I minima** | | | | |
|---|---|---|---|---|
| **DECISION HEIGHT (*Note 7*)** | **Facilities / RVR (*Note 5*)** | | | |
| | **FULL (*Notes 1 and 6*)** | **INTERIM (*Notes 2 and 6*)** | **BASIC (*Notes 3 and6*)** | **NIL (*Notes 4 and 6*)** |
| 200 ft | 550 m | 700 m | 800 m | 1,000 m |
| 201-250 ft | 600 m | 700 m | 800 m | 1,000 m |
| 251-300 ft | 650 m | 800 m | 900 m | 1,200 m |
| 301 ft and above | 800 m | 900 m | 1,000 m | 1,200 m |

*Note 1:* Full facilities comprise runway markings, 720m or more of HI/MI approach lights, runway edge lights, threshold lights and runway end lights. Lights must be on.

*Note 2:* Intermediate facilities comprise runway markings, 420-719m of HI/MI approach lights, runway edge lights, threshold lights and runway end lights. Lights must be on.

*Note 3:* Basic facilities comprise runway markings, <420m of HI/MI approach lights, any length of LI approach lights, runway edge lights, threshold lights and runway end lights. Lights must be on.

*Note 4:* Nil approach light facilities comprise runway markings, runway edge lights, threshold lights, runway end lights, or no lights at all.

*Note 5:* The above figures are either the reported RVR or meteorological visibility converted to RVR in accordance with paragraph (h).

*Note 6:* The Table is applicable to conventional approaches with a glide slope angle up to and including 4° (degree).

*Note 7:* The DH mentioned in the Table 5 refers to the initial calculation of DH. When selecting the associated RVR, there is no need to take account of a rounding up to the nearest ten feet, which may be done for operational purposes, (e.g. conversion to DA).

5. **Single pilot operations**. For single pilot operations, an operator must calculate the minimum RVR for all approaches in accordance with OPS 1.430 and this Appendix. An RVR of less than 800m is not permitted except when using a suitable autopilot coupled to an ILS or MLS, in which case normal minima apply. The Decision Height applied must not be less than 1.25 x the minimum use height for the autopilot.

6. **Night operations.** For night operations at least runway edge, threshold and runway end lights must be on.

(d) **Precision Approach — Category II Operations**

1. **General.** A Category II operation is a precision instrument approach and landing using ILS or MLS with:
   (i) A decision height below 200 ft but not lower than 100 ft; and

(ii) A runway visual range of not less than 300 m.

2. **Decision Height.** An operator must ensure that the decision height for a Category II operation is not lower than:

(i) The minimum decision height specified in the AFM, if stated;

(ii) The minimum height to which the precision approach aid can be used without the required visual reference;

(iii) The OCH/OCL for the category of aeroplane;

(iv) The decision height to which the flight crew is authorised to operate; or

(v) 100 ft.

3. **Visual reference.** A pilot may not continue an approach below the Category II decision height determined in accordance with subparagraph (d)(2) above unless visual reference containing a segment of at least 3 consecutive lights being the centre line of the approach lights, or touchdown zone lights, or runway centre line lights, or runway edge lights, or a combination of these is attained and can be maintained. This visual reference must include a lateral element of the ground pattern, i.e. an approach lighting crossbar, or the landing threshold, or a barrette of the touchdown approach lighting; such as an approach lighting crossbar, or the landing threshold, or a barrette of the touchdown zone lighting.

4. **Required RVR.** The lowest minima to be used by an operator for Category II operations are:

**Table 6 - RVR for Cat II approach v/s DH**

| **Category II minima** | | |
|---|---|---|
| **DECISION HEIGHT** | **Auto-coupled to below DH (*see Note 1*)** | |
| | **RVR/Aeroplane Category A, B & C** | **RVR/Aeroplane Category D** |
| **100 ft-120 ft** | 300 m | 300 m (*Note 2*) / 350 m |
| **121 ft-140 ft** | 400 m | 400 m |
| **141 ft and above** | 450 m | 450 m |

*Note 1:* The reference to ‘auto-coupled to below DH’ in this table means continued use of the automatic flight control system down to a height which is not greater than 80 % of the applicable DH. Thus airworthiness requirements may, through minimum engagement height for the automatic flight control system, affect the DH to be applied.

*Note 2:* 300 m may be used for a Category D aeroplane conducting an auto land.

**(e) Precision Approach — Category III Operations**

1. **General.** Category III operations are subdivided as follows:

(i) Category IIIA operations. A precision instrument approach and landing using ILS or MLS with:

(A) A decision height lower than 100 ft; and

(B) A runway visual range not less than 200 m.

(ii) Category IIIB operations. A precision instrument approach and landing using ILS or MLS with:

(A) A decision height lower than 50 ft, or no decision height; and

(B) A runway visual range lower than 200 m but not less than 75 m.

*Note:* Where the decision height (DH) and runway visual range (RVR) do not fall within the same category, the RVR will determine in which category the operation is to be considered.

2. **Decision Height.** For operations in which a decision height is used, an operator must ensure that the decision height is not lower than:

(i) The minimum decision height specified in the AFM, if stated;

(ii) The minimum height to which the precision approach aid can be used without the required visual reference; or

(iii) The decision height to which the flight crew is authorised to operate.

3. **No Decision Height Operations**. Operations with no decision height may only be conducted if:

(i) The operation with no decision height is authorised in the AFM;

(ii) The approach aid and the aerodrome facilities can support operations with no decision height; and

(iii) The operator has an approval for CAT III operations with no decision height.

*Note:* In the case of a CAT III runway it may be assumed that operations with no decision height can be supported, unless specifically restricted as published in the AIP or NOTAM.

4. **Visual reference**

(i) For Category IIIA operations, and for category IIIB operations with fail-passive flight control systems, a pilot may not continue an approach below the decision height determined in accordance with subparagraph (e)(2) above unless a visual reference containing a segment of at least 3 consecutive lights being the centreline of the approach lights, or touchdown zone lights, or runway centre line lights, or runway edge lights, or a combination of these is attained and can be maintained.

(ii) For Category IIIB operations with fail-operational flight control systems using a decision height, a pilot may not continue an approach below the Decision Height, determined in accordance with subparagraph (e)(2) above, unless a visual reference containing at least one centreline light is attained and can be maintained.

(iii) For Category III operations with no decision height there is no requirement for visual contact with the runway prior to touchdown.

5. **Required RVR**. The lowest minima to be used by an operator for Category III operations are:

***Table 7* - RVR for Cat III approach v/s DH and roll-out control/guidance system**

| **Category III minima** | | | |
|---|---|---|---|
| **APPROACH CATEGORY** | **DECISION HEIGHT (ft) (*Note 3*)** | **ROLL-OUT CONTROL GUIDANCE SYSTEM** | **RVR (m)** |
| III A | Less than 100 ft | Not required | 200 m (*Note 1*) |
| III B | Less than 100 ft | Fail-passive | 150 m (*Notes 1 and 2*) |
| III B | Less than 50 ft | Fail-passive | 125 m |
| III B | Less than 50 ft, or No Decision Height | Fail-operational | 75 m |

*Note 1:* Crew actions in case of autopilot failure at or below decision height in fail-passive Category III operations

*Note 2:* For aeroplanes certificated in accordance with CS-AWO on all weather operations 321(b)(3), see 321(b)(3) – (Installed Equipment) therein.

*Note 3:* Flight control system redundancy is determined under CS-AWO on all weather operations by the minimum certificated decision height.

(f) **Circling**

1. **The lowest minima to be used** by an operator for circling are:

**Table 8 - Visibility and MDH for circling v/s aeroplane category**

| | **Aeroplane Category** | | | |
|---|---|---|---|---|
| | **A** | **B** | **C** | **D** |
| **MDH** | 400 ft | 500 ft | 600 ft | 700 ft |
| **Minimum meteorological visibility** | 1,500 m | 1,600 m | 2,400 m | 3,600 m |

2. **Circling with prescribed tracks** is an accepted procedure within the meaning of this paragraph

(g) **Visual Approach**

An operator shall not use an RVR of less than 800 m for a visual approach.

**(h) Conversion of Reported Meteorological Visibility to RVR**

(1) An operator must ensure that a meteorological visibility to RVR conversion is not used for calculating take-off minima, Category II or III minima, or when a reported RVR is available.

*Note:* If the RVR is reported as being above the maximum value assessed by the aerodrome operator, e.g. 'RVR more than 1,500 metres', it is not considered to be a reported RVR in this context and the Conversion Table may be used.

(2) When converting meteorological visibility to RVR in all other circumstances than those in subparagraph (h)(1) above, an operator must ensure that the following Table is used:

**Table 9 - Conversion of visibility to RVR**

| Lighting elements in operation | RVR = Reported Met. Visibility x | |
|---|---|---|
| | Day | Night |
| HI approach and runway lighting | 1.5 | 2.0 |
| Any type of lighting installation other than above | 1.0 | 1.5 |
| No lighting | 1.0 | Not applicable |

**END of APPENDIX 1 (Old) to OPS 1.430 - Aerodrome Operating Minima**

## 3. APPENDIX 1 (New) to OPS 1.430 - AERODROME OPERATING MINIMA

### (a) Take-off Minima

1. **General**

(i) Take-off minima established by the operator must be expressed as visibility or RVR limits, taking into account all relevant factors for each aerodrome planned to be used and the aeroplane characteristics. Where there is a specific need to see and avoid obstacles on departure and/or for a forced landing, additional conditions (e.g. ceiling) must be specified.

(ii) The commander shall not commence take-off unless the weather conditions at the aerodrome of departure are equal to or better than applicable minima for landing at that aerodrome, unless a suitable take-off alternate aerodrome is available.

(iii) When the reported meteorological visibility is below that required for take-off and RVR is not reported, a take-off may only be commenced if the commander can determine that the RVR/visibility along the take-off runway is equal to or better than the required minimum.

(iv) When no reported meteorological visibility or RVR is available, a take-off may only be commenced if the commander can determine that the RVR/visibility along the take-off runway is equal to or better than the required minimum.

2. **Visual reference.** The take-off minima must be selected to ensure sufficient guidance to control the aeroplane in the event of both a discontinued take-off in adverse circumstances and a continued take-off after failure of the critical power unit.

3. **Required RVR/Visibility**

(i) For multi-engine aeroplanes, whose performance is such that, in the event of a critical power unit failure at any point during take-off, the aeroplane can either stop or continue the take-off to a height of 1,500 ft above the aerodrome while clearing obstacles by the required margins, the take-off minima established by an operator must be expressed as RVR/Visibility values not lower than those given in Table 1 below except as provided in paragraph (4) below:

**Table 1 – RVR / Visibility for take-off**

| Take-off RVR / Visibility | |
|---|---|
| **Facilities** | **RVR/Visibility (See *Note 3*)** |
| Nil (Day only) | 500 m |
| Runway edge lighting and/or centreline marking | 250/300 m (*Notes 1 and 2*) |
| Runway edge & centreline lights | 200/250 m (*Note 1*) |
| Runway edge and centreline lighting + multiple RVR readings | 150/200 m (*Notes 1 and 4*) |

*Note 1:* The higher values apply to Category D aeroplanes.

*Note 2:* For night operations at least runway edge and runway end lights are required.

*Note 3:* The reported RVR/Visibility value representative of the initial part of the take-off run can be replaced by pilot assessment.

*Note 4:* The required RVR value must be achieved for all of the relevant RVR reporting points with the exception given in Note 3 above.

| Comparable Values of RVR & Ground Visibility | | |
|---|---|---|
| **RVR Feet** | **Visibility Statute Miles** | **Equivalent RVR Meters** |
| 1600 | 1/4 | 500 |
| 2000 | 3/8 | 600 |
| 2400 | 1/2 | 700 |
| 3200 | 5/8 | 950 |
| 4000 | 3/4 | 1,200 |
| 4500 | 7/8 | 1,350 |
| 5000 | 1 | 1,500 |
| 6000 | 1¼ | 2,000 |

(ii) For multi-engine aeroplanes whose performance is such that they cannot comply with the performance conditions in subparagraph (a)(3)(i) above in the event of a critical power unit failure, there may be a need to re-land immediately and to see and avoid obstacles in the take-off area. Such aeroplanes may be operated to the following take-off minima, provided they are able to comply with the applicable obstacle clearance criteria, assuming engine failure at the height specified. The take-off minima established by an operator must be based upon the height from which the one engine inoperative net take-off flight path can be constructed. The RVR minima used may not be lower than either of the values given in Table 1 above or Table 2 below.

**Table 2 - Assumed engine failure height above the runway versus RVR/Visibility**

| **Take-off RVR/Visibility — Flight path** | |
|---|---|
| **Assumed engine failure height above the take-off runway** | **RVR/Visibility (*Note 2*)** |
| < 50 ft | 200 m |
| 51-100 ft | 300 m |
| 101-150 ft | 400 m |
| 151-200 ft | 500 m |
| 201-300 ft | 1,000 m |
| > 300 ft | 1,500 m (*Note 1*) |

*Note 1:* 1,500 m is also applicable if no positive take-off flight path can be constructed.

*Note 2:* The reported RVR/Visibility value representative of the initial part of the take-off run can be replaced by pilot assessment.

(iii) When reported RVR, or meteorological visibility is not available, the commander shall not commence take-off unless he/she can determine that the actual conditions satisfy the applicable take-off minima.

4. **Exceptions to paragraph (a)(3)(i) above:**

(i) Subject to the approval of the Authority, and provided the requirements in sub-headings (A) to (E) below have been satisfied, an operator may reduce the take-off minima to 125 m RVR (Category A, B and C aeroplanes) or 150 m RVR (Category D aeroplanes) when:

(A) Low Visibility Procedures are in force;

(B) High intensity runway centreline lights spaced 15 m or less and high intensity edge lights spaced 60 m or less are in operation;

(C) Flight crew members have satisfactorily completed training in a Flight Simulator;

(D) A 90 m visual segment is available from the cockpit at the start of the take-off run; and

(E) The required RVR value has been achieved for all of the relevant RVR reporting points.

(ii) Subject to the approval of the Authority, an operator of an aeroplane using either:

(A) an approved lateral guidance system; or,

(B) an approved HUD/HUDLS for take-off may reduce the take-off minima to an RVR less than 125 m (Category A, B and C aeroplanes) or 150 m (Category D eroplanes) but not lower than 75 m provided runway protection and facilities equivalent to Category III landing operations are available.

(b) **Category I - APV and non-precision approach operations**

1. **A Category I approach operation** is a precision instrument approach and landing using ILS, MLS, GLS (GNSS/GBAS) or PAR with a decision height not lower than 200 ft and with an RVR not less than 550 m, unless accepted by the Authority.

2. **A non-precision approach (NPA) operation** is an instrument approach using any of the facilities described in Table 3 (System minima), with a MDH or DH not lower than 250 ft and an RVR/CMV of not less than 750 m, unless accepted by the Authority.

3. **An APV operation** is an instrument approach which utilises lateral and vertical guidance, but does not meet the requirements established for precision approach and landing operations, with a DH not lower than 250 ft and a runway visual range of not less than 600m unless approved by the Authority.

4. **Decision height (DH).** An operator must ensure that the decision height to be used for an approach is not lower than:
   (i) the minimum height to which the approach aid can be used without the required visual reference; or
   (ii) the OCH for the category of aeroplane; or
   (iii) the published approach procedure decision height where applicable; or
   (iv) 200 ft for Category I approach operations; or
   (v) the system minimum in Table 3; or
   (vi) the lowest decision height specified in the Aeroplane Flight Manual (AFM) or equivalent document, if stated; whichever is higher.

5. **Minimum descent height (MDH).** An operator must ensure that the minimum descent height for an approach is not lower than:
   (i) the OCH for the category of aeroplane; or
   (ii) the system minimum in Table 3; or
   (iii) the minimum descent height specified in the Aeroplane Flight Manual (AFM) if stated; whichever is higher.

6. **Visual reference**. A pilot may not continue an approach below DA/MDH unless at least one of the following visual references for the intended runway is distinctly visible and identifiable to the pilot:
   (i) elements of the approach light system;
   (ii) the threshold;
   (iii) the threshold markings;
   (iv) the threshold lights;
   (v) the threshold identification lights;
   (vi) the visual glide slope indicator;
   (vii) the touchdown zone or touchdown zone markings;
   (viii) the touchdown zone lights;
   (ix) runway edge lights; or
   (x) other visual references accepted by the Authority.

**Table 3 - System minima v/s facilities**

| System minima | |
|---|---|
| **Facility** | **Lowest DH/ MDH** |
| Localiser with or without DME | 250 ft |
| SRA (terminating at 1/2 NM) | 250 ft |
| SRA (terminating at 1 NM) | 300 ft |
| SRA (terminating at 2 NM) | 350 ft |
| RNAV/LNAV | 300 ft |
| VOR | 300 ft |
| VOR/DME | 250 ft |
| NDB | 350 ft |
| NDB/DME | 300 ft |
| VDF | 350 ft |

(c) **Criteria for establishing RVR/Converted Met Visibility (Ref Table 6)**

1. T**o qualify for the lowest allowable values of RVR/CMV detailed in Table 6** (applicable to each approach grouping) the instrument approach shall meet at least the following facility requirements and associated conditions:
   (i) Instrument approaches with designated vertical profile up to and including 4,5° for Category A and B aeroplanes, or 3,77° for Category C and D aeroplanes, unless other approach angles are approved by the Authority, where the facilities are:
   (A) ILS/MLS/GLS/PAR; or
   (B) APV; and
   where the final approach track is offset by not more than 15° for Category A and B aeroplanes or by not more than 5° for Category C and D aeroplanes.

(ii) Instrument approaches flown using the CDFA technique with a nominal vertical profile, up to and including 4,5° for Category A and B aeroplanes, or 3,77° for Category C and D aeroplanes, unless other approach angles are approved by the Authority where the facilities are NDB, NDB/DME, VOR, VOR/DME, LLZ, LLZ/DME, VDF, SRA or NAV/LNAV, with a final-approach segment of at least 3NM, which also fulfil the following criteria:

(A) The final approach track is offset by not more than 15° for Category A and B aeroplanes or by not more than 5° for Category C and D aeroplanes; and

(B) The FAF or another appropriate fix where descent is initiated is available, or distance to THR is available by FMS/RNAV or DME; and

(C) If the MAPt is determined by timing, the distance from FAF to THR is ≤ 8 NM.

(iii) Instrument approaches where the facilities are NDB, NDB/DME, VOR, VOR/DME, LLZ, LLZ/DME, VDF, SRA or RNAV/LNAV, not fulfilling the criteria in paragraph (c)1.(ii) above, or with an MDH ≥ 1,200 ft.

2. **The missed approach,** after an approach has been flown using the CDFA technique, shall be executed when reaching the decision altitude (height) or the MAPt, whichever occurs first. The lateral part of the missed approach procedure must be flown via the MAPt , unless otherwise stated on the approach chart.

(d) **Determination of RVR/CMV/Visibility minima for Cat I, APV & non-precision approach operations**

1. **The minimum RVR/CMV/Visibility** shall be the highest of the values derived from Table 5 or Table 6 but not greater than the maximum values shown in Table 6, where applicable.

2. **Values in Table 5** are derived from the formula below.
Required RVR/visibility (m) = [(DH/MDH (ft) × 0.3048)/tan α] – length of approach lights (m)

*Note 1:* 'α' is the calculation angle, being a default value of 3.00 degrees increasing in steps

3. **The formula may be used** with the approval of the Authority, with the actual approach slope and/or the actual length of the approach lights for a particular runway.

4. **If the approach is flown with a level flight segment at or above MDA/H**, 200 metres shall be added for Cat A and B aeroplane and 400 metres for Cat C and D aeroplane to the minimum RVR/CMV value resulting from the application of Tables 5 and 6.

*Note:* The added value corresponds to the time/distance required to establish the aeroplane on the final descent.

5. **An RVR of less than 750 m as indicated in Table 5 may be used:**

(i) for Category I approach operations to runways with FALS (see below), Runway Touchdown Zone Lights (RTZL) and Runway Centreline Lights (RCLL), provided that the DH is not more than 200 ft; or

(ii) for Category I approach operations to runways without RTZL and RCLL, when using an approved HUDLS, or equivalent approved system, or when conducting a coupled approach or flight-director-flown approach to a DH equal to or greater than 200 ft., the ILS must not be promulgated as a restricted facility; or

(iii) for APV approach operations to runways with FALS, RTZL and RCLL when using an approved HUD.

6. **The Authority may approve RVR values lower than those given in Table 5**, for HUDLS and auto-land operations in accordance with paragraph (e) of this Appendix.

7. **The visual aids** comprise standard runway day markings and approach and runway lighting (runway edge lights, threshold lights, runway end lights and in some cases also touch-down zone and/or runway centre line lights). The approach light configurations acceptable are classified and listed in Table 4 below.

8. **Notwithstanding the requirements in paragraph (d)(7) above**, the authority may approve that RVR values relevant to a Basic Approach Lighting System (BALS) are used on runways where the approach lights are restricted in length below 210m due to terrain or water, but where at least one cross-bar is available.

9. **For night operations** or for any operation where credit for runway and approach lights is required, the lights must be on and serviceable except as provided for in Table 6a.

**Table 4 – Approach Light systems**

| OPS Class of Facility | Length, configuration and intensity of approach lights |
|---|---|
| **FALS (full approach light system)** | ICAO: Precision approach CAT I Lighting System (HIALS 720 m ≥) distance coded centreline, Barrette centreline |
| **IALS (intermediate approach light system)** | ICAO: Simple approach lighting system (HIALS 420-719 m) single source, Barrette |
| **BALS (basic approach light system)** | Any other approach lighting System (HIALS, MIALS or ALS 210-419 m |
| **NALS (no approach light system)** | Any other approach lighting system (HIALS, MIALS or ALS < 210 m) or no approach lights |

**Table 5 - RVR/CMV (See Table 11) v. DH/MDH**

| DH or MDH | | | Class of Lighting Facility | | | |
|---|---|---|---|---|---|---|
| | | | FALS | IALS | BALS | NALS |
| | | | See paragraphs (d)5, (d)6 and (d)10 about RVR < 750 m | | | |
| Feet | | | Metres | | | |
| 481 | — | 500 | 1 500 | 1 800 | 2 100 | 2 300 |
| 501 | — | 520 | 1 600 | 1 900 | 2 100 | 2 400 |
| 521 | — | 540 | 1 700 | 2 000 | 2 200 | 2 400 |
| 541 | — | 560 | 1 800 | 2 100 | 2 300 | 2 500 |
| 561 | — | 580 | 1 900 | 2 200 | 2 400 | 2 600 |
| 581 | — | 600 | 2 000 | 2 300 | 2 500 | 2 700 |
| 601 | — | 620 | 2 100 | 2 400 | 2 600 | 2 800 |
| 621 | — | 640 | 2 200 | 2 500 | 2 700 | 2 900 |
| 641 | — | 660 | 2 300 | 2 600 | 2 800 | 3 000 |
| 661 | — | 680 | 2 400 | 2 700 | 2 900 | 3 100 |
| 681 | — | 700 | 2 500 | 2 800 | 3 000 | 3 200 |
| 701 | — | 720 | 2 600 | 2 900 | 3 100 | 3 300 |
| 721 | — | 740 | 2 700 | 3 000 | 3 200 | 3 400 |
| 741 | — | 760 | 2 700 | 3 000 | 3 300 | 3 500 |
| 761 | — | 800 | 2 900 | 3 200 | 3 400 | 3 600 |
| 801 | — | 850 | 3 100 | 3 400 | 3 600 | 3 800 |
| 851 | — | 900 | 3 300 | 3 600 | 3 800 | 4 000 |
| 901 | — | 950 | 3 600 | 3 900 | 4 100 | 4 300 |
| 951 | — | 1 000 | 3 800 | 4 100 | 4 300 | 4 500 |
| 1 001 | — | 1 100 | 4 100 | 4 400 | 4 600 | 4 900 |
| 1 101 | — | 1 200 | 4 600 | 4 900 | 5 000 | 5 000 |
| 1 201 and above | | | 5 000 | 5 000 | 5 000 | 5 000 |

**Table 6 - Minimum and maximum applicable RVR/converted met visibility (see Table 11) for all instrument approaches down to CAT I minima (lower and upper cut-off limits):**

| Facility / conditions | RVR/CMV (m) | Aeroplane category | | | |
|---|---|---|---|---|---|
| | | A | B | C | D |
| **ILS, MLS, GLS, PAR and APV** | **Min** | According to Table 5 | | | |
| | **Max** | 1 500 | 1 500 | 2 400 | 2 400 |
| **NDB, NDB/DME, VOR, VOR/DME, LLZ, LLZ/DME, VDF, SRA, RNAV/LNAV with a procedure which fulfils the criteria in paragraph (c)1.(ii):** | **Min** | 750 | 750 | 750 | 750 |
| | **Max** | 1 500 | 1 500 | 2 400 | 2 400 |
| **For NDB, NDB/DME, VOR, VOR/DME, LLZ, LLZ/DME, VDF, SRA, RNAV/LNAV:**<br>**- not fulfilling the criteria in paragraph (c)1.(ii) above, or**<br>**- with a DH or MDH ≥ 1 200 ft** | **Min** | 1 000 | 1 000 | 1 200 | 1 200 |
| | **Max** | According to Table 5 if flown using the CDFA technique, otherwise an add-on of 200/400m applies to the values in Table 5 but not to result in a value exceeding 5 000m. | | | |

**Table 6a - Failed or downgraded equipment — effect on landing minima:**

| Failed or downgraded equipment *(Note 1)* | Effect on landing minima | | | | |
|---|---|---|---|---|---|
| | **CAT IIIB** *(Note 2)* | **CAT IIIA** | **CAT II** | **CAT I** | **Non precision** |
| **ILS stand-by transmitter** | Not allowed | | No effect | | |
| **Outer Marker** | No effect if replaced by published equivalent position | | | | Not applicable |
| **Middle marker** | No effect | | | | No effect unless used as MAPT |
| **Touchdown zone RVR assessment system** | May be temporarily replaced with midpoint RVR if approved by the State of the aerodrome. RVR may be reported by human observation | | | No effect | |
| **Midpoint or stop-end RVR** | No effect | | | | |
| **Anemometer for runway in use** | No effect if other ground source available | | | | |
| **Celiometer** | No effect | | | | |
| **Approach lights** | Not allowed for operations with DH > 50 ft | | Not allowed | minima as for nil facilities | |
| **Approach lights except the last 210 m** | No effect | | Not allowed | minima as for nil facilities | |
| **Approach lights except the last 420 m** | No effect | | | minima as for intermediate facilities | |
| **Standby power for approach lights** | No effect | | | | |
| **Whole runway light system** | Not allowed | | | **Day** - minima as for nil facilities<br>**Night -** Not allowed | |
| **Edge lights** | **Day only** - Night not allowed | | | | |

*Note 1:* Conditions applicable to Table 6a:

(a) multiple failures of runway lights other than indicated in Table 6a are not acceptable.

(b) deficiencies of approach and runway lights are treated separately.

(c) Category II or III operations. A combination of deficiencies in runway lights and RVR assessment equipment is not allowed.

(d) failures other than ILS affect RVR only and not DH.

*Note 2:* For CAT IIIB operations with no DH, an operator shall ensure that, for aeroplanes authorised to conduct no DH operations with the lowest RVR limitations, the following applies in addition to the content of Table 6a:

(a) RVR. At least one RVR value must be available at the aerodrome;

(b) runway lights

(i) no runway edge lights, or no centre lights — Day — RVR 200 m; night — not allowed;

(ii) no TDZ lights — no restrictions;

(iii) no standby power to runway lights — Day — RVR 200 m; night — not allowed.

10. **Single pilot operations.** For single pilot operations, an operator must calculate the minimum RVR/visibility for all approaches in accordance with OPS 1.430 and this Appendix.

(i) An RVR of less than 800 metres as indicated in Table 5 may be used for Category I approaches provided any of the following is used at least down to the applicable DH:

(A) a suitable autopilot, coupled to an ILS or MLS which is not promulgated as restricted; or

(B) an approved HUDLS (including, where appropriate, EVS), or equivalent approved system.

(ii) Where RTZL and/or RCLL are not available, the minimum RVR/CMV shall not be less than 600 m.

(iii) An RVR of less than 800 metres as indicated in Table 5, may be used for APV operations to runways with FALS, RTZL and RCLL when using an approved HUDLS, or equivalent approved system, or when conducting a coupled approach to a DH equal to or greater than 250 ft.

(e) **Lower than Standard Category I Operations**

1. **Decision height**.

A lower than Standard Category I Operation decision height must not be lower than:

(i) the minimum decision height specified in the AFM, if stated; or

(ii) the minimum height to which the precision approach aid can be used without the required visual reference; or

(iii) the OCH for the category of aeroplane; or

(iv) the decision height to which the flight crew is authorised to operate; or

(v) 200 ft.

whichever is higher.

2. **Type of facility.**

An ILS/MLS which supports a lower than Standard Category I operation must be an unrestricted facility with a straight-in course (≤ 3º offset) and the ILS must be certificated to:

(i) Class I/T/1 for operations to a minimum of 450m RVR; or

(ii) Class II/D/2 for operations to less than 450m RVR.

Single ILS facilities are only acceptable if Level 2 performance is provided.

3. **Required RVR/CMV.**

The lowest minima to be used by an operator for lower than Standard Category I operations are stipulated in Table 6b below:

**Table 6b - Lower than Standard Category I Minimum RVR/CMV v. approach light system**

| Lower than Standard Category I minima | | | | | | |
|---|---|---|---|---|---|---|
| DH(ft) | | | Class of lighting facility | | | |
| | | | FALS | IALS | BALS | NALS |
| | | | RVR/CMV (metres) | | | |
| 200 | — | 210 | 400 | 500 | 600 | 750 |
| 211 | — | 220 | 450 | 550 | 650 | 800 |
| 221 | — | 230 | 500 | 600 | 700 | 900 |
| 231 | — | 240 | 500 | 650 | 750 | 1 000 |
| 241 | — | 249 | 550 | 700 | 800 | 1 000 |

*Note 1:* The visual aids comprise standard runway day markings, approach lighting, runway edge lights, threshold lights, runway end lights and, for operations below 450m, shall include touch-down zone and/or runway centre line lights.

4. **Visual reference.**

A pilot shall not continue an approach below decision height unless visual reference containing a segment of at least three consecutive lights being the centre line of the approach lights, or touchdown zone lights, or runway centre line lights, or runway edge lights, or a combination of these is attained and can be maintained. This visual reference must include a lateral element of the ground pattern, i.e. an approach lighting crossbar or the landing threshold or a barrette of the touchdown zone lighting unless the operation is conducted utilising an approved HUDLS usable to at least 150 feet.

5. **Approval.**

To conduct lower than Standard Category I operations:

(i) the approach shall be flown auto-coupled to an auto-land; or an approved HUDLS shall be used to at least 150 ft above the threshold.

(ii) the aeroplane shall be certificated in accordance with CS-AWO to conduct Category II operations;

(iii) the auto-land system shall be approved for Category IIIA operations;

(iv) in service proving requirements shall be completed in accordance with Appendix 1 to OPS 1.440 paragraph (h);

(v) training specified in Appendix 1 to OPS 1.450 paragraph (h) shall be completed. This shall include training and checking in a Flight Simulator using the appropriate ground and visual aids at the lowest applicable RVR;

(vi) the Operator must ensure that Low Visibility procedures are established and in operation at the intended aerodrome of landing; and

(vii) the Operator shall be approved by the Authority.

(f) **Precision approach — Category II and other than Standard Category II operations**

1. **General.**

(i) A Category II operation is a precision instrument approach and landing using ILS or MLS with:

(A) A decision height below 200 ft but not lower than 100 ft; and

(B) A runway visual range of not less than 300 m.

(ii) An other than Standard Category II operation is a precision instrument approach and landing using ILS or MLS which meets facility requirements as established in paragraph (iii) below with:

(A) A decision height below 200 ft but not lower than 100 ft; (See Table 7b below) and

(B) A runway visual range of not less than 350/400 m. (See Table 7b below)

(iii) The ILS/MLS that supports other than a Standard Category II operation shall be an unrestricted facility with a straight in course (≤ 3o offset) and the ILS shall be certificated to:

(A) Class I/T/1 for operations down to 450m RVR and to a DH of 200 ft or more; or,

(B) Class II/D/2 for operations in RVRs of less than 450m or to a DH of less than 200 ft.

Single ILS facilities are only acceptable if Level 2 performance is provided.

2. **Decision Height.** An operator must ensure that the decision height for:

(i) Other than Standard Category II and Category II operations is not lower than:

(A) The minimum decision height specified in the AFM, if stated; or

(B) The minimum height to which the precision approach aid can be used without the required visual reference; or

(C) The OCH for the category of aeroplane; or

(D) The decision height to which the flight crew is authorised to operate; or

(E) 100 ft.

whichever is higher.

3. **Visual reference**.

A pilot may not continue an approach below either the Category II or the other than Standard Category II decision height determined in accordance with subparagraph (d)2., above unless visual reference containing a segment of at least 3 consecutive lights being the centre line of the approach lights, or touchdown zone lights, or runway centre line lights, or runway edge lights, or a combination of these is attained and can be maintained. This visual reference must include a lateral element of the ground pattern, i.e. an approach lighting crossbar or the landing threshold or a barrette of the touchdown zone lighting, unless the operation is conducted utilising an approved HUDLS to touchdown.

4. **Required RVR.**

(i) The lowest minima to be used by an operator for Category II operations are:

**Table 7a - RVR for Cat II operations v. DH**

| | Category II minima | |
|---|---|---|
| | Auto-coupled/Approved HUDLS to below DH *(Note 1a)* | |
| DH(ft) | RVR Aeroplane Category A, B and C | RVR Aeroplane Category D |
| 100-120 | 300 m | 300/350m *(Note 2a)* |
| 121-140 | 400 m | 400 m |
| 141 and above | 450 m | 450m |

*Note 1a:* The reference to 'auto-coupled to below DH/Approved HUDLS' in this table means continued use of the automatic flight control system or the HUDLS down to a height of 80 % of the DH. Thus airworthiness requirements may, through minimum engagement height for the automatic flight control system, affect the DH to be applied.

*Note 2a:* 300m may be used for a Category D aeroplane conducting an auto-land.

(ii) Required RVR.

The lowest minima to be used by an operator for other than Standard Category II operations are:

**Table 7b - Other than Standard Category II Minimum RVR v. approach light system**

| | Other than Standard Category II minima | | | | |
|---|---|---|---|---|---|
| | Auto-land or approved HUDLS utilised to touchdown | | | | |
| | Class of lighting facility | | | | |
| | FALS | | IALS | BALS | NALS |
| | See paragraph (d)5, (d)6 and (d)10. about RVR < 750m | | | | |
| | CAT A-C | CAT D | CAT A-D | CAT A-D | CAT A-D |
| DH (ft) | RVR metres | | | | |
| 100-120 | 350 | 400 | 450 | 600 | 700 |
| 121-140 | 400 | 450 | 500 | 600 | 700 |
| 141-160 | 450 | 500 | 500 | 600 | 750 |
| 161-199 | 450 | 500 | 550 | 650 | 750 |

*Note:* The visual aids required to conduct other than Standard Category II Operations comprise standard runway day markings and approach and runway lighting (runway edge lights, threshold lights, runway end lights). For operations in RVR of 400 m or less, centre line lights must be available. The approach light configurations are classified and listed in Table 4 above.

(iii) To conduct other than Standard Category II operations the operator must ensure that appropriate low visibility procedures are established and in operation at the intended aerodrome of landing.

(g) **Precision approach — Category III operations**

1. **General**.

Category III operations are subdivided as follows:

(i) Category III A operations. A precision instrument approach and landing using ILS or MLS with:

(A) a decision height lower than 100 ft; and

(B) a runway visual range not less than 200 m.

(ii) Category III B operations. A precision instrument approach and landing using ILS or MLS with:

(A) a decision height lower than 100 ft, or no decision height; and

(B) a runway visual range lower than 200 m but not less than 75 m.

*Note:* Where the decision height (DH) and runway visual range (RVR) do not fall within the same Category, the RVR will determine in which Category the operation is to be considered.

2. **Decision height.**

For operations in which a decision height is used, an operator must ensure that the decision height is not lower than:

(i) the minimum decision height specified in the AFM, if stated; or

(ii) the minimum height to which the precision approach aid can be used without the required visual reference; or

(iii) the decision height to which the flight crew is authorised to operate.

3. **No decision height operations**.

Operations with no decision height may only be conducted if:

(i) the operation with no decision height is authorised in the AFM; and

(ii) the approach aid and the aerodrome facilities can support operations with no decision height; and

(iii) the operator has an approval for CAT III operations with no decision height.

*Note:* In the case of a CAT III runway it may be assumed that operations with no decision height can be supported unless specifically restricted as published in the AIP or NOTAM.

4. **Visual reference**

(i) For Category IIIA operations, and for Category IIIB operations conducted either with fail-passive flight control systems, or with the use of an approved HUDLS, a pilot may not continue an approach below the decision height determined in accordance with subparagraph (g)2 above unless a visual reference containing a segment of at least three consecutive lights being the centreline of the approach lights, or touchdown zone lights, or runway centreline lights, or runway edge lights, or a combination of these is attained and can be maintained.

(ii) For Category IIIB operations conducted either with fail-operational flight control systems or with a fail-operational hybrid landing system (comprising e.g. a HUDLS) using a decision height, a pilot may not continue an approach below the decision height, determined in accordance with subparagraph (e)2 above, unless a visual reference containing at least one centreline light is attained and can be maintained.

5. **Required RVR**. The lowest minima to be used by an operator for Category III operations are:

**Table 8 - RVR for Cat III Operations v. DH and roll-out control/guidance system**

| **Category III minima** | | | |
|---|---|---|---|
| **Category** | **Decision height (ft)** ***(Note 2)*** | **Roll-out control/Guidance system** | **RVR (m)** |
| **IIIA** | Less than 100 ft | Not required | 200 m |
| **IIIB** | Less than 100 ft | Fail-passive | 150 m *(Note 1)* |
| **IIIB** | Less than 50 ft | Fail-passive | 125 m |
| **IIIB** | Less than 50 ft or No decision height | Fail-operational *(Note 3)* | 75 m |

*Note 1:* For aeroplanes certificated in accordance with CS-AWO 321(b)3 or equivalent.

*Note 2:* Flight control system redundancy is determined under CS-AWO by the minimum certificated decision height.

*Note 3*: The fail-operational system referred to may consist of a fail-operational hybrid system.

(h) **Enhanced vision systems**

1. A pilot using an enhanced vision system certificated for the purpose of this paragraph and used in accordance with the procedures and limitations of the approved flight manual, may:

(i) continue an approach below DH or MDH to 100 feet above the threshold elevation of the runway, provided that at least one of the following visual references is displayed and identifiable on the enhanced vision system:

(A) elements of the approach lighting; or

(B) the runway threshold, identified by at least one of the following: the beginning of the runway landing surface, the threshold lights, the threshold identification lights; and the touchdown zone, identified by at least one of the following: the runway touchdown zone landing surface, the touchdown zone lights, the touchdown zone markings or the runway lights;

(ii) reduce the calculated RVR/CMV for the approach from the value in column 1 of Table 9 below to the value in column 2:

**Table 9 - Approach utilising EVS RVR/CMV reduction v. normal RVR/CMV**

| RVR/CMV normally required | RVR/CMV for approach utilising EVS |
|---|---|
| 550 | 350 |
| 600 | 400 |
| 650 | 450 |
| 700 | 450 |
| 750 | 500 |
| 800 | 550 |
| 900 | 600 |
| 1 000 | 650 |
| 1 100 | 750 |
| 1 200 | 800 |
| 1 300 | 900 |
| 1 400 | 900 |
| 1 500 | 1 000 |
| 1 600 | 1 100 |
| 1 700 | 1 100 |
| 1 800 | 1 200 |
| 1 900 | 1 300 |
| 2 000 | 1 300 |
| 2 100 | 1 400 |
| 2 200 | 1 500 |
| 2 300 | 1 500 |
| 2 400 | 1 600 |
| 2 500 | 1 700 |
| 2 600 | 1 700 |
| 2 700 | 1 800 |
| 2 800 | 1 900 |
| 2 900 | 1 900 |
| 3 000 | 2 000 |
| 3 100 | 2 000 |
| 3 200 | 2 100 |
| 3 300 | 2 200 |
| 3 400 | 2 200 |
| 3 500 | 2 300 |
| 3 600 | 2 400 |
| 3 700 | 2 400 |
| 3 800 | 2 500 |
| 3 900 | 2 600 |
| 4 000 | 2 600 |
| 4 100 | 2 700 |
| 4 200 | 2 800 |
| 4 300 | 2 800 |

| RVR/CMV normally required | RVR/CMV for approach utilising EVS |
|---|---|
| 4 400 | 2 900 |
| 4 500 | 3 000 |
| 4 600 | 3 000 |
| 4 700 | 3 100 |
| 4 800 | 3 200 |
| 4 900 | 3 200 |
| 5 000 | 3 300 |

2. Paragraph (h)1 above may only be used for ILS, MLS, PAR, GLS and APV Operations with a DH no lower than 200 feet ,or an approach flown using approved vertical flight path guidance to a MDH or DH no lower than 250 feet.

3. A pilot may not continue an approach below 100 feet above runway threshold elevation for the intended runway, unless at least one of the visual references specified below is distinctly visible and identifiable to the pilot without reliance on the enhanced vision system:
   (A) The lights or markings of the threshold; or
   (B) The lights or markings of the touchdown zone.

(i) **Intentionally left blank**

(j) **Circling**

1. **Minimum descent height (MDH).** The MDH for circling shall be the higher of:
   (i) the published circling OCH for the aeroplane category; or
   (ii) the minimum circling height derived from Table 10 below; or
   (iii) the DH/MDH of the preceding instrument approach procedure.

2. **Minimum descent altitude (MDA).** The MDA for circling shall be calculated by adding the published aerodrome elevation to the MDH, as determined by 1 above.

3. **Visibility**. The minimum visibility for circling shall be the higher of:
   (i) the circling visibility for the aeroplane category, if published; or
   (ii) the minimum visibility derived from Table 10 below; or
   (iii) the RVR/CMV derived from Tables 5 and 6 for the preceding instrument approach procedure.

4. Notwithstanding the requirements in subparagraph 3 above, an Authority may exempt an operator from the requirement to increase the visibility above that derived from Table 10.

5. Exemptions as described in subparagraph 4 must be limited to locations where there is a clear public interest to maintain current operations. The exemptions must be based on the operator's experience, training programme and flight crew qualification. The exemptions must be reviewed at regular intervals.

**Table 10 - Minimum visibility and MDH for circling v. aeroplane category**

| | Aeroplane Category | | | |
|---|---|---|---|---|
| | A | B | C | D |
| **MDH (ft)** | 400 | 400 | 600 | 700 |
| **Minimum meteorological visibility (m)** | 1 500 | 1 600 | 2 400 | 3 600 |

*Note:* Circling with prescribed tracks is an accepted procedure within the meaning of this paragraph.

(k) **Visual approach.** An operator shall not use an RVR of less than 800 m for a visual approach.

(l) **Conversion of reported meteorological visibility to RVR/CMV.**

1. An operator must ensure that a meteorological visibility to RVR/CMV conversion is not used for takeoff, for calculating any other required RVR minimum less than 800 m, or when reported RVR is available.

*Note:* If the RVR is reported as being above the maximum value assessed by the aerodrome operator, e.g. 'RVR more than 1 500 metres', it is not considered to be a reported value for the purpose of this paragraph.

2. When converting meteorological visibility to RVR in all other circumstances than those in subparagraph (l)1 above, an operator must ensure that the following T able is used:

**Table 11- Conversion of met visibility to RVR/CMV**

| Lighting elements in operation | RVR / CMV = Reported met Visibility x | |
|---|---|---|
| | Day | Night |
| **HI approach and runway lighting** | 1.5 | 2.0 |
| **Any type of lighting installation other than above** | 1.0 | Not Applicable |
| **No lighting** | 1.0 | |

**END of APPENDIX 1 (New to OPS 1.430 - Aerodrome Operating Minima**

## 4. APPENDIX 2 TO OPS 1.430 (c) - Aeroplane Categories — All Weather Operations (AWO)

(a) **Classification of aeroplanes**

The criteria taken into consideration for the classification of aeroplanes by categories is the indicated airspeed at threshold (VAT) which is equal to the stalling speed (VSO) multiplied by 1.3, or VS1G multiplied by 1.23 in the landing configuration at the maximum certificated landing mass. If both VSO and VS1G are available, the higher resulting VAT shall be used. The aeroplane categories corresponding to VAT values are in the Table below:

| Aeroplane Category | VAT, Vth or Vref |
|---|---|
| **A** | Less than 91 kt |
| **B** | From 91 to 120 kt |
| **C** | From 121 to 140 kt |
| **D** | From 141 to 165 kt |
| **E** | From 166 to 210 kt |

The landing configuration which is to be taken into consideration shall be defined by the operator or by the aeroplane manufacturer.

(b) **Permanent change of category (maximum landing mass)**

1. An operator may impose a permanent, lower, landing mass, and use this mass for determining the VAT if approved by the Authority.

2. The category defined for a given aeroplane shall be a permanent value and thus independent of the changing conditions of day-to-day operations.

## 5. APPENDIX 1 TO OPS 1.440 - Low Visibility Operations — General Operating Rules

(a) **General.** The following procedures apply to the introduction and approval of low visibility operations.

(b) **Operational demonstration**. The purpose of the operational demonstration is to determine or validate the use and effectiveness of the applicable aircraft flight guidance systems, including HUDLS if appropriate, training, flight crew procedures, maintenance programme and manuals applicable to the Category II/III programme being approved.

1. At least 30 approaches and landings must be accomplished in operations using the Category II/III systems installed in each aircraft type if the requested DH is 50 ft or higher. If the DH is less than 50 ft, at least 100 approaches and landings will need to be accomplished unless otherwise approved by the Authority.

2. If an operator has different variants of the same type of aircraft utilising the same basic flight control and display systems, or different basic flight control and display systems on the same type of aircraft, the operator must show that the various variants have satisfactory performance, but the operator need not conduct a full operational demonstration for each variant. The Authority may also accept a reduction of the number of approach and landings based on credit given for the experience gained by another operator with an AOC issued in accordance with OPS 1 using the same aeroplane type or variant and procedures.

3. If the number of unsuccessful approaches exceeds 5 % of the total (e.g. unsatisfactory landings, system disconnects) the evaluation programme must be extended in steps of at least 10 approaches and landings until the overall failure rate does not exceed 5 %.

(c) **Data collection for operational demonstrations.**

Each applicant must develop a data collection method (e.g. a form to be used by the flight crew) to record approach and landing performance. The resulting data and a summary of the demonstration data shall be made available to the Authority for evaluation.

(d) **Data analysis**. Unsatisfactory approaches and/or automatic landings shall be documented and analysed.

(e) **Continuous monitoring**

1. After obtaining the initial authorisation, the operations must be continuously monitored by the operator to detect any undesirable trends before they become hazardous. Flight crew reports may be used to achieve this.

2. The following information must be retained for a period of 12 months:
   (i) the total number of approaches, by aeroplane type, where the airborne Category II or III equipment was utilised to make satisfactory, actual or practice approaches to the applicable Category II or III minima; and
   (ii) reports of unsatisfactory approaches and/or automatic landings, by aerodrome and aeroplane registration, in the following categories:
      (A) airborne equipment faults;
      (B) ground facility difficulties;
      (C) missed approaches because of ATC instructions; or
      (D) other reasons.

3. An operator must establish a procedure to monitor the performance of the automatic landing system or HUDLS to touchdown performance, as appropriate, of each aeroplane.

(f) **Transitional periods**

1. **Operators with no previous Category II or III experience**
   (i) An operator without previous Category II or III operational experience may be approved for Category II or IIIA operations, having gained a minimum experience of six months of Category I operations on the aeroplane type.
   (ii) On completing six months of Category II or IIIA operations on the aeroplane type the operator may be approved for Category IIIB operations. When granting such an approval, the Authority may impose higher minima than the lowest applicable for an additional period. The increase in minima will normally only refer to RVR and/or a restriction against operations with no decision height and must be selected such that they will not require any change of the operational procedures.

*2.* **Operators with previous Category II or III experience.**
   (i) An operator with previous Category II or III experience may obtain authorisation for a reduced transition period by application to the Authority.
   (ii) An operator authorised for Category II or III operations using auto-coupled approach procedures, with or without auto-land, and subsequently introducing manually flown Category II or III operations using a HUDLS shall be considered to be a 'New Category II/III operator' for the purposes of the demonstration period provisions.

(g) **Maintenance of Category II, Category III and LVTO equipment.** Maintenance instructions for the on-board guidance systems must be established by the operator, in liaison with the manufacturer, and included in the operator's aeroplane maintenance programme prescribed in Part M, paragraph M.A.302 which must be approved by the Authority.

(h) **Eligible aerodromes and runways**

1. Each aeroplane type/runway combination must be verified by the successful completion of at least one approach and landing in Category II or better conditions, prior to commencing Category III operations.

2. For runways with irregular pre-threshold terrain, or other foreseeable or known deficiencies, each aeroplane type/runway combination must be verified by operations in standard Category I or better conditions, prior to commencing Lower than Standard Category I, Category II, or 'Other than Standard' Category II or Category III operations.

3. If an operator has different variants of the same type of aeroplane in accordance with subparagraph 4 below, utilising the same basic flight control and display systems, or different basic flight control and display systems on the same type of aeroplane in accordance with subparagraph 4 below, the operator must show that the variants have satisfactory operational performance, but the operator need not conduct a full operational demonstration for each variant/runway combination.

4. For the purpose of paragraph (h), an aeroplane type or variant of an aeroplane type is deemed to be the same type/variant of aeroplane if that type/variant has the same or similar:
   - (i) level of technology, including the:
     - (A) FGS and associated displays and controls;
     - (B) the FMS and level of integration with the FGS;
     - (C) use of HUDLS.
   - (ii) Operational procedures, including:
     - (A) alert height;
     - (B) manual landing/automatic landing;
     - (C) no decision height operations;
     - (D) use of HUD/HUDLS in hybrid operations.
   - (iii) Handling characteristics, including:
     - (A) manual landing from automatic or HUDLS guided approach;
     - (B) manual go-around from automatic approach;
     - (C) automatic/manual roll out.

5. Operators using the same aeroplane type/class or variant of a type in accordance with subparagraph 4 above may take credit from each others' experience and records in complying with this paragraph.

6. Operators conducting Other than Standard Category II operations shall comply with Appendix 1 to OPS 1.440 — Low Visibility Operations — General Operating Rules applicable to Category II operations.

6. **OPS 1.450 - Low Visibility Operations — Training and Qualifications**
**See EASA core documentation & The AWOPS Guide, published in autumn 2010**

7. **APPENDIX 1 TO OPS 1.455 - Low Visibility Operations — Operating Procedures**

(a) **General.** Low visibility operations include:

1. manual take-off (with or without electronic guidance systems or HUDLS/-Hybrid HUD/HUDLS);

2. auto-coupled approach to below DH, with manual flare, landing and rollout;

3. approach flown with the use of a HUDLS/Hybrid HUD/HUDLS and/or EVS);

4. auto-coupled approach followed by auto-flare, auto landing and manual roll-out; and

5. auto-coupled approach followed by auto-flare, auto landing and auto-rollout, when the applicable RVR is less than 400 m.

*Note 1:* A hybrid system may be used with any of these modes of operations.

*Note 2:* Other forms of guidance systems or displays may be certificated and approved.

(b) **Procedures and operating instructions**

1. The precise nature and scope of procedures and instructions given depend upon the airborne equipment used and the flight deck procedures followed. An operator must clearly define flight crew member duties during take-off, approach, flare, roll-out and missed approach in the Operations Manual. Particular emphasis must be placed on flight crew responsibilities during transition from non-visual conditions to visual conditions, and on the procedures to be used in deteriorating visibility or when failures occur. Special attention must be paid to the distribution of flight deck duties so as to ensure that the workload of the pilot making the decision to land or execute a missed approach enables him/her to devote himself/herself to supervision and the decision making process.

2. An operator must specify the detailed operating procedures and instructions in the Operations Manual. The instructions must be compatible with the limitations and mandatory procedures contained in the Aeroplane Flight Manual and cover the following items in particular:

(i) checks for the satisfactory functioning of the aeroplane equipment, both before departure and in flight;

(ii) effect on minima caused by changes in the status of the ground installations and airborne equipment;

(iii) procedures for the take-off, approach, flare, landing, roll-out and missed approach;

(iv) procedures to be followed in the event of failures, warnings to include HUD/HUDLS/EVS and other non-normal situations;

(v) the minimum visual reference required;

(vi) the importance of correct seating and eye position;

(vii) action which may be necessary arising from a deterioration of the visual reference;

(viii) allocation of crew duties in the carrying out of the procedures according to subparagraphs (i) to (iv) and (vi) above, to allow the Commander to devote himself/herself mainly to supervision and decision making;

(ix) the requirement for all height calls below 200 ft to be based on the radio altimeter and for one pilot to continue to monitor the aeroplane instruments until the landing is completed;

(x) the requirement for the Localiser Sensitive Area to be protected;

(xi) the use of information relating to wind velocity, wind shear, turbulence, runway contamination and use of multiple RVR assessments;

(xii) procedures to be used for:

(A) lower than Standard Category I;

(B) other than Standard Category II;

(C) approaches utilising EVS; and

(D) practice approaches and landing on runways at which the full Category II or Category III aerodrome procedures are not in force;

(xiii) operating limitations resulting from airworthiness certification; and

(xiv) information on the maximum deviation allowed from the ILS glide path and/or localiser.

## 8. APPENDIX 1 to OPS 1.465 - Minimum Visibilities for VFR Operations

| **Airspace class** | **A B C D E** *(Note 1)* | **F G** | |
|---|---|---|---|
| | | Above 900 m (3 000 ft) AMSL or above 300 m (1 000 ft) above terrain, whichever is the higher | At and below 900 m (3 000 ft) AMSL or 300 m (1 000 ft) above terrain, whichever is the higher |
| **Distance from cloud** | 1 500 m horizontally<br>300 m (1 000 ft) vertically | | Clear of cloud and in sight of the surface |
| **Flight visibility** | 8 km at and above 3 050 m (10 000 ft) AMSL *(Note 2)*<br>5 km below 3 050 m (10 000 ft) AMSL | | 5 km *(Note 3)* |

*Note 1:* VMC minima for Class A airspace are included for guidance but do not imply acceptance of VFR Flights in Class A Airspace

*Note 2:* When the height of the transition altitude is lower than 3 050 m (10 000 ft) AMSL, FL 100 should be used in lieu of 10 000 ft.

*Note 3:* Cat A and B aeroplanes may be operated in flight visibilities down to 3 000 m, provided the appropriate ATS authority permits use of a flight visibility less than 5 km, and the circumstances are such, that the probability of encounters with other traffic is low, and the IAS is 140 kt or less.

## 9. Instrument Approaches - Aerodrome Operating Minima (AOM) Summary

| Approach Category | Decision Height Minimum (Feet) | Minimum RVR (Metres) | Approach Type |
|---|---|---|---|
| **Cat 1 ILS** | 200 ft | 550 m RVR or 800m visibility | Manual or auto to a landing (manual or auto) |
| **Cat 2 ILS** | Between 100 ft – 200 ft | 350 m RVR * | Auto for manual land or autoland |
| **Cat 3a ILS** | Less than 100 ft | 200 m RVR * | Auto to Autoland |
| **Cat 3b ILS** | Less than 50 ft | Less than 200 m RVR * but not less than 50 m | Auto to Autoland |
| **Cat 3b ILS - Nil DH** | 0 ft - wheels on ground | 0 metres | Auto to Autoland |

**See Precision Approach - Category I & II Operations (Tables 10 and 11)** for variation of RVR depending upon Approach lighting.

**END OF APPENDIX E**

# APPENDIX F – AIRPORTS AND LOW VISIBILITY OPERATIONS INFRASTRUCTURE

**CONTENTS**



## 1. OVERVIEW OF AIRPORT OPERATIONS REQUIREMENTS

### 1.1 GENERAL AIRPORT MARKINGS & EQUIPMENT OPERATIONAL REQUIREMENTS

#### 1.1.1 Introduction

The procedures and items listed below are basic information for operators and pilots concerning specific rules and regulations for low visibility operations, including Cat 2 (II) approaches with or without autoland and Cat 3 (III) arrivals with autoland, or low visibility take-offs. ATC applies special safeguards and procedures for LVO that become effective in relation to specified weather conditions. These procedures are intended to provide protection for aircraft operating in low visibility and to avoid disturbances to the ILS signals.

#### 1.1.2 Categories of Precision Operations (See *'2. Definitions'* hereunder for details)

Category 1 (Cat 1) ILS Operation - (ILSC1)
Category 2 (Cat 2) ILS Operation - (ILSC2)
Category 3a (CAT 3a) ILS Operation - (ILSC3)
Category 3b (CAT 3b) ILS Operation - (ILSC3)
Low visibility take-off (LVTO)

### 1.2 APPLICABLE ICAO DOCUMENTS & SIGNIFICANT AIRPORT REQUIREMENTS

ICAO Annex 6 - Operation of Aircraft
ICAO Annex 10, Volume I - Aeronautical Telecommunications
ICAO Annex 14 - Aerodromes
ICAO Document 4444 - Rules of the Air & Air Traffic Services
ICAO Document 8168 PANS-OPS - Aircraft Operations
ICAO Document 8071 - Manual on Testing of Radio-Navigation Aids
ICAO Document 9365-AN/910 - Manual of All Weather Operations.
ICAO Document 9476-AN/927 - Manual of Surface Movement Guidance & Control System
ECAC Document 17 - Common European Procedures for Cat 2 & Cat 3 ILS Operations

## 1.3 AIRPORTS

**The most significant requirements, procedures and additional regulations therein are summarised below.**

### 1.3.1 Aerodrome facilities

a. **Physical Characteristics**

Runways and taxiways of aerodromes must be designed and operated according to the *ICAO Annex 14 - Standards and Recommended Practices* appropriate to the category of their certified operation:

i. for Cat 2 & 3 approach and landing, or auto landing on each suitable runway; and

ii. for Low visibility take-off movements from each suitable runway

b. **Obstacle Clearance Criteria and Obstacle Free Zone (OFZ**)

The aerodromes and the airspace around the aerodromes shall be kept free of obstacles rising above the precision approach obstacle limitation surfaces, as defined in *ICAO Annex 14, chapter 4 and Document 8168 PANS-OPS, Volume II*. An object which penetrates one of the obstacle limitation surfaces becomes the controlling obstacle for calculating the OCA/OCH.

During Cat 2 and Cat 3 Operations, the Obstacle Free Zone (OFZ) shall be kept clear of all obstacles, such as vehicles, persons and aircraft, at all times when an aircraft making an approach is below 200ft. Essential equipment and installations in the vicinity of the runway which are necessary because of their function for air navigation purposes (GP antenna, RVR assessment units, etc.) must be situated clear of the OFZ and of be of minimum mass and frangibly mounted.

**c. Pre-threshold Terrain**

A Precision Approach Terrain Chart according to the *Standards and Recommended Practices of Annex 4 and 14* is to be provided for each runway certified for Cat 2 and Cat 3 ILS Operations.

## 1.4 VISUAL AIDS

### 1.4.1 Approach lighting

Approach lighting for precision approach runways must be in compliance with *ICAO Annex 14* Standards and Recommended Practices

***AWOPS Runway with Calvert & Supplementary Approach Lighting in last 1000 feet***

**ALSF-2 Airport Rechnology.com/ Binrock.net / USAF/FAA photo**

### 1.4.2 Approach Lights Categories

| FAA CAT | EASA EQUIVALENT | EU/JAR designator & Category |
|---|---|---|
| (A) ALSF-2 | Full | PALS 2/3 Cat 2 or 3 |
| (A1) ALSF-1 | Full | PALS 1 Cat 1 |
| (A3) SSALR | Full | SSLAR Cat 1 |
| (A5) MALSR | Full | MALSR Cat 1 |
| (A2) SALS | Intermediate | Calvert CD5B1 or 2 - 5 bar - Cat 1 or 2 |
| (A2) SALSF | Intermediate | Calvert CL5B (5 bar) Cat 1 |
| (A4) MALS | Intermediate | Calvert CL4B (4 bar) Cat 1 |
| (A4) MALSF | Intermediate | BCL4B 'bar centerline' & 4 bars - Cat 1 |
| (A4) SSALS | Intermediate | SALSR Cat 1 |
| (A4) SSALF | Intermediate | Cat 1 |
| ODALS | Basic | Visual |

**PALS 2 Lighting** **NASA PD Photo**

### 1.4.3 Approach & Runway Lighting Glossary

**CD5B** (**CALVERT**) Colour coded approach lighting system with 5 bars; if known, suffixed (**- 1)** for ILS Cat 1 configuration and **(- 2)** for Cat 2 configuration. Red Barrettes in last 1000ft (305m) of ALS centreline.

**CGL** Circle Guidance Light(s)

**CL-1B** Centreline with one bar (single row not coded). May be up to CL-7B (with up to 7 bars). Prefixed by 'B' indicates bar centreline.

**F** Sequenced flashing lights.

**LDIN** Sequenced flashing lead-in lights.

**MALS** Medium intensity approach lighting system.

**MALSF** Medium intensity approach lighting system with sequenced flashing lights.

**MALSR** Medium intensity approach lighting system with runway alignment indicator lights.

**NATO** North Atlantic Treaty Organisation standard system (Military). Centre-line & 5 bar (CL-5B).

**ODALS** Omni-directional sequenced flashing lead-in lighting system.

**PALS -1** Precision Approach lighting with sequenced flashing lights in ILS Cat 1 configuration.

**PALS -2** Precision Approach lighting with red barrettes + sequenced flashing lights in ILS Cat 2 configuration.

**RAI** Runway alignment indicator lights. Only installed with other lighting systems.

**RAL BCN** Runway alignment beacon at distance from threshold indicated.

**SALS** Short or Simple approach lighting system.

**SALSF** Short or Simple approach lighting system with sequenced flashing lights.

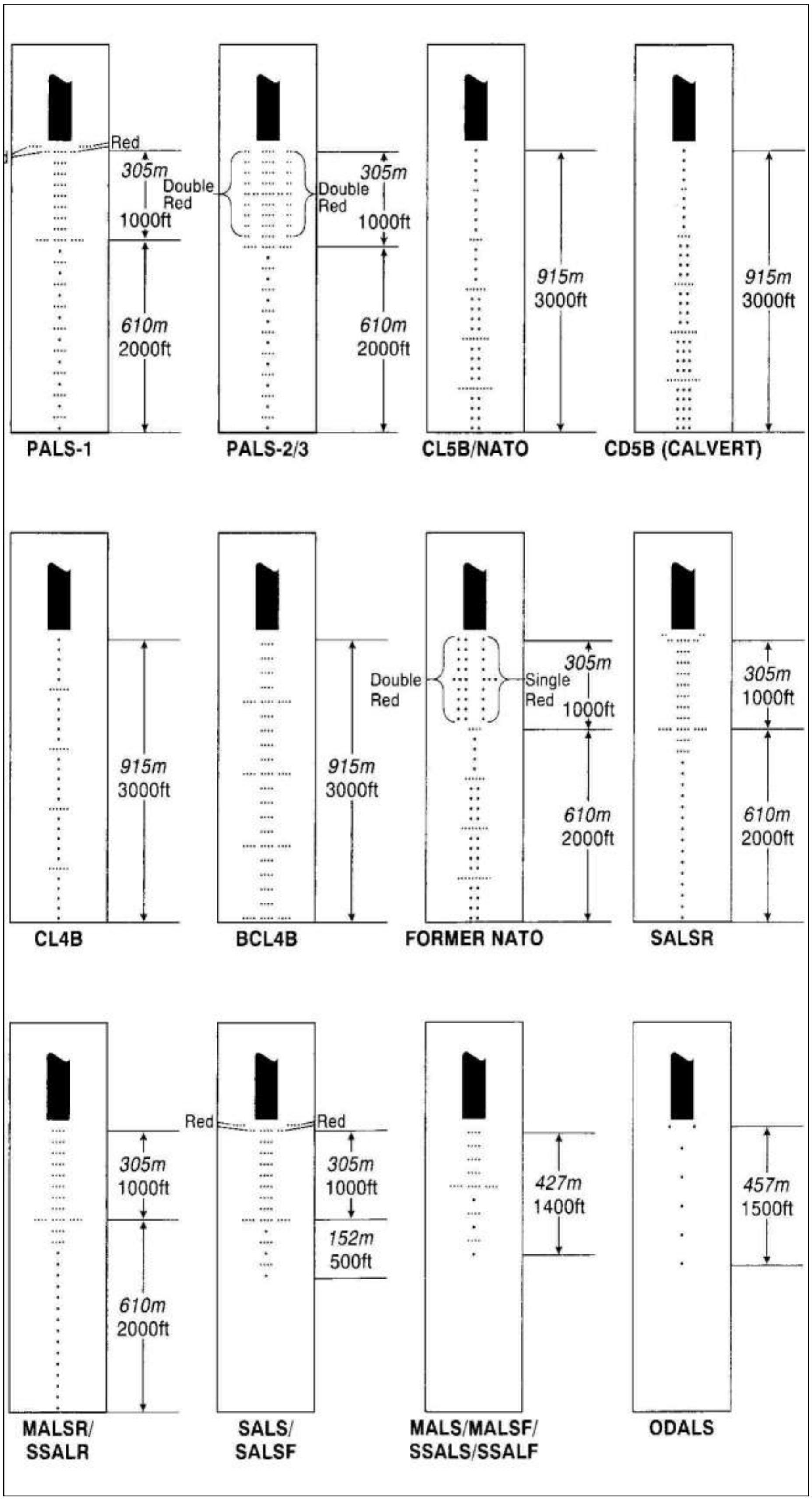
**SALSR** Short or Simple approach lighting system with runway alignment indicator lights.

**SSALS** Simplified short approach lighting system. May be installed with SALSF and SALSR

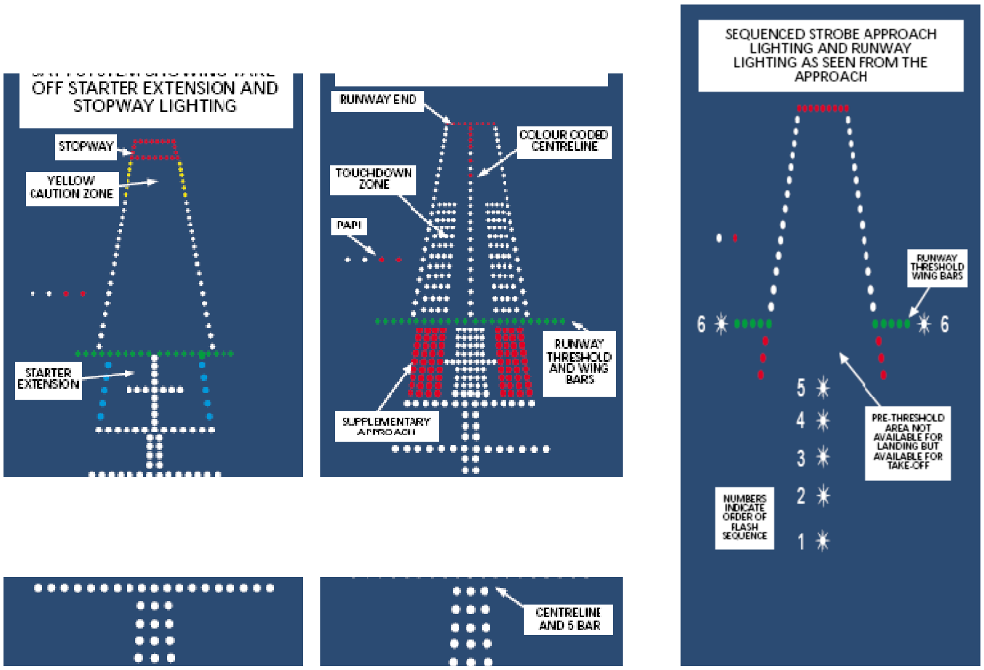
**SHINGALS** Supplementary high intensity narrow gauge approach lighting system.

**T (Red T)** Normally used with other lighting systems; located at runway end of approach lighting.

**1.4.4 Approach Lighting Systems (Source: 1AIDU (RAF)**

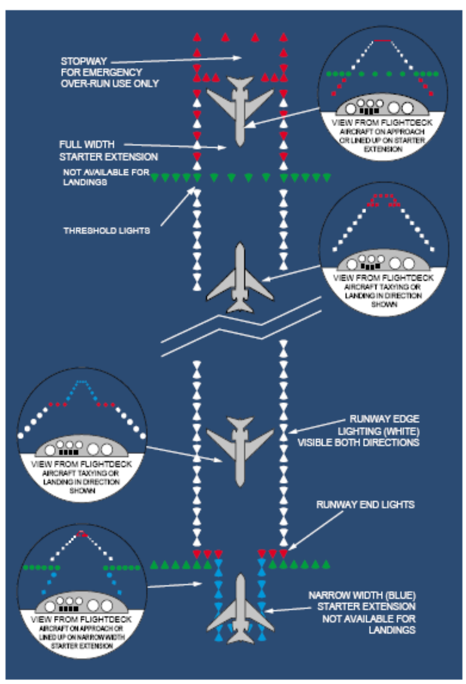


### 1.5 APPROACH LIGHTING AND RUNWAY LIGHTS PATTERNS - Illustrations from UK CAA CAP 637



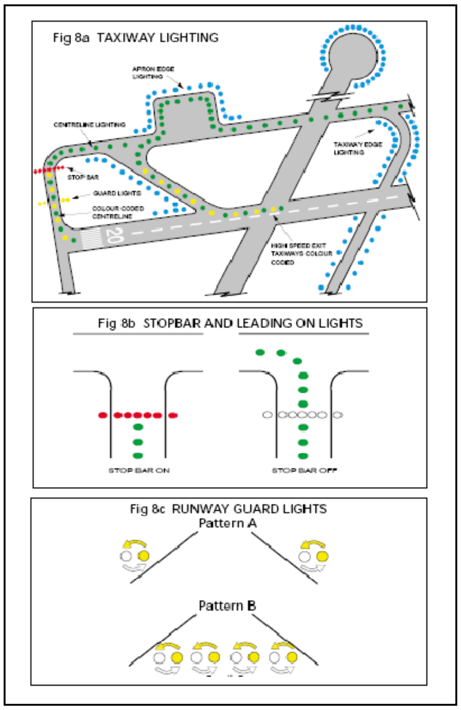

#### 1.5 .1 RUNWAY LIGHTING AND MARKINGS

Runway lighting and marking must be in compliance with *ICAO Annex 14 Standards and Recommended Practices.* Runways certified for Cat 2 and Cat 3 ILS Operations must be equipped accordingly, including threshold lighting, runway markings, runway edge lighting, runway-end lighting and markings, runway centre line lighting and markings and touch down zone lighting and markings.




**Runway edge, Threshold & Ends lighting**
**As seen from the flight deck looking ahead**

## 1.6 TAXIWAY LIGHTING, MARKINGS AND STOP-BARS (Source UK CAA CAP 637)




• Taxiway lighting and marking is in compliance with *ICAO Annex 14 Standards and Recommended Practices*

• Stop bars, taxi-holding positions and illuminated notice boards must be installed to provide adequate clearance for aircraft taxiing to and from the runway.

• Taxiways leading to or from runways intended to be used during Cat 2 and Cat 3 weather conditions must be equipped with centreline lights. Taxiway centreline lights within the LLZ sensitive area must be colour-coded alternately yellow then green, to indicate to pilots exiting the runway they are still in the protected area. When the aircraft is clear of the LLZ sensitive area, the lights change to 'all green'. At this point, a "runway vacated" call can be made to ATC.

• Pairs of 'Wig-Wag' RUNWAY GUARD lights are mounted one pair per side of the taxiway at Cat 2/Cat 3 stop bars, where painted on the taxiway. The lights are turned on and flash alternately when LVO procedures are in force, to attract the pilot's attention and reinforce the position of the stop bar. These wig-wag lights are in addition to the illuminated RED marker boards placed on either side of the taxiway to identify the holding point.

• The illustrations give examples of runway identification boards, and taxiway "holding point" marker boards (WHITE letters on a RED background). Taxiway edge lights are BLUE and stop-bar lights across taxiways are RED. Taxiway "lead-on" centreline lights are GREEN, but note the alternating YELLOW/GREEN centreline lights from the runway to a taxiway leading off the runway, until the taxiway is outside the protected LVO conditions area, after which the taxiway centreline lights become ALL GREEN.

## 1.7 MANDATORY SIGNS FOR AIRCRAFT SURFACE MOVEMENTS (Source UK CAA CAP 637)

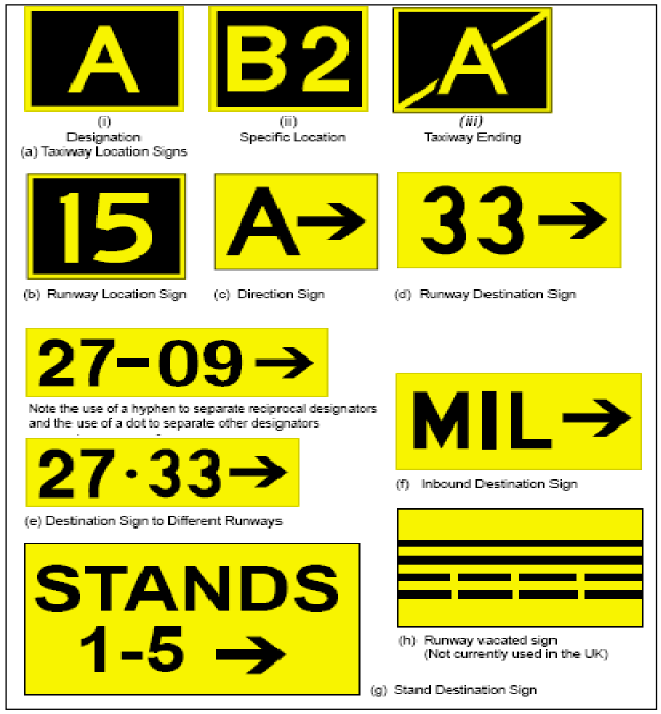
| | | | |
|---|---|---|---|
| a. | **Visual Runway Taxi-holding Position** denotes the visual Taxi-Holding position and also the ILS Cat 1 Holding Position where the Visual and Cat 1 Holding Positions are co-located. | i.<br>ii. | 27<br>09–27 |
| b. | **Cat I Runway Taxi-Holding Position Sign** Denotes ILS Cat I Taxi-Holding Position only where a visual holding position is established closer to the runway to expedite traffic flow. | i.<br>ii. | 27 CAT I<br>09–27 CAT I |
| c. | **Cat II Runway Taxi-Holding Position Sign** Marks the ILS Cat II Taxi-Holding Position. A Visual Cat I Taxi-Holding Position may be established closer to the runway where it is necessary to expedite traffic flow | i.<br>ii. | 27 CAT II<br>09–27 CAT II |
| d. | **Cat III Runway Taxi-Holding Position Sign** Marks the ILS Cat II Taxi-Holding Position. A Cat 2 Taxi-Holding Position & a Visual Cat I Taxi-Holding Position may be established closer to the runway where it is necessary to expedite traffic flow | i.<br>ii. | 27 CAT III<br>09–27 CAT III |
| e. | **Combined Runway Taxi-Holding Position Sign** marks the Taxi-Holding Position where the ILS- Taxi-Holding positions are co-incident. A Visual or Cat I **T**axi-Holding Position Sign may be placed closer to the runway where it is necessary to expedite traffic flow | i.<br>ii. | 27 CAT II/III<br>27 CAT I/II/III<br>09–27 CAT II/III |
| f. | **Intermediate Taxi-/holding Position Sign** Marks a Holding Position established to protect a priority route | | B2 |
| g. | **No Entry Sign** | | ⊖ |
| **Notes** | **The signs (i) are used where the taxiway serves only one runway direction.**<br>**The signs (ii) are used where the taxiway normally serves both runway directions** | | |

### 1.7.1 HOLD POSITION SIGN IN PLACE & EXAMPLES OF INFORMATION SIGNS

**'Hold Position' sign on site**

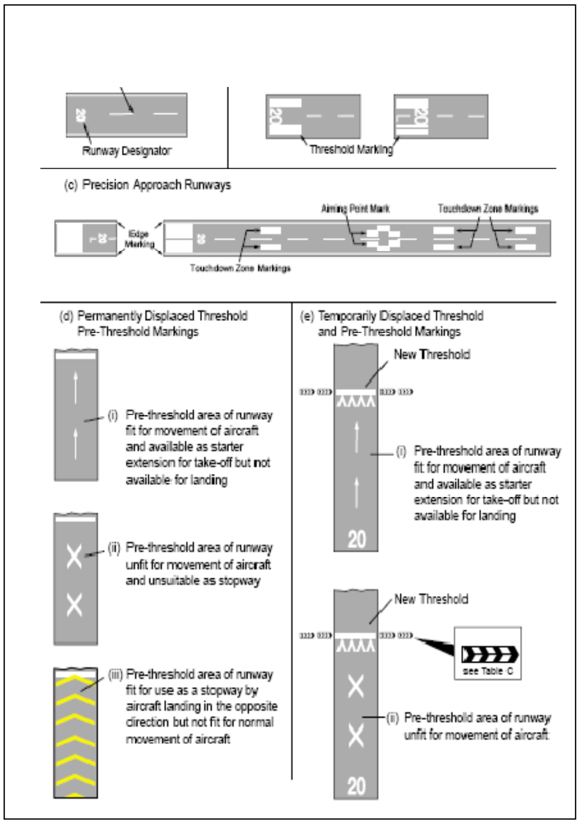
- Is used to denote the entrance to a runway or critical area in conjunction with hold bars.
- Has white inscriptions with red backgrounds.
- Must not be passed unless permission is granted by ATC.
- Should be **NOTAMed** when unavailable or unlit.

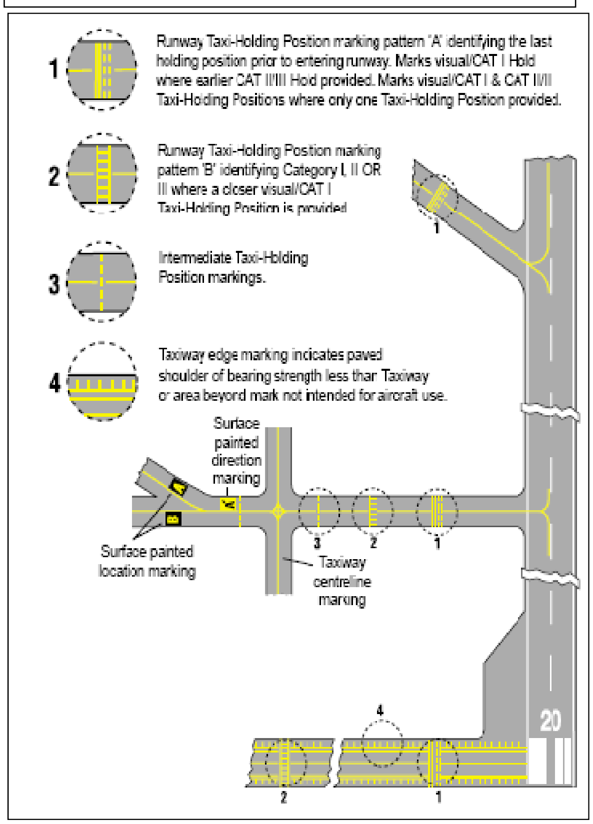
**Source FAA**




**Information & direction signs** (Source UK CAA CAP 637)

## 1.8 PAVED RUNWAY MARKINGS

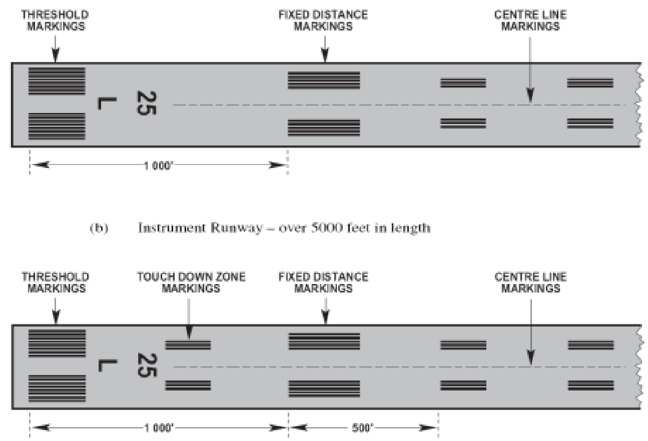



(Source UK CAA CAP 637)

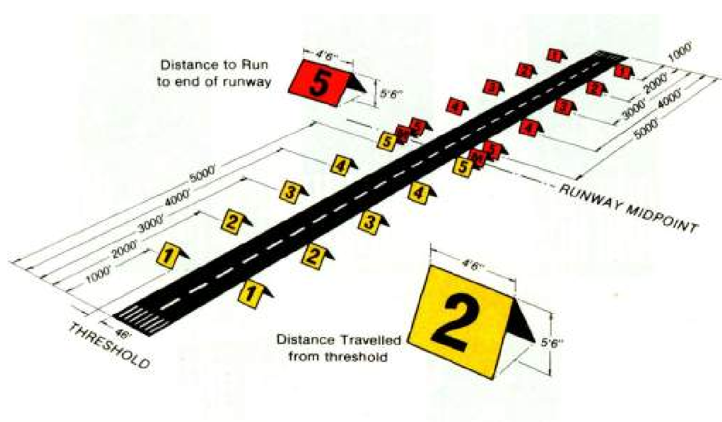
(Source UK CAA CAP 637)

### 1.8.1. **Non Instrument Runway over 5,000 feet in length** (Illustration Source: 1 AIDU (RAF))




### 1.8.2 **Civil Runway Marker Board System** (Illustration Source: 1 AIDU (RAF))

1. Marker Boards are 5 ½ feet high and 4 ½ feet wide, positioned 46 feet from the runway lights.
2. The boards indicate:
   **a.** **Yellow:** distance travelled from threshold (e.g. 1= 1000ft; 2 = 2000ft)
   b. **Red:** length of runway remaining (e.g. 3 = 3,000 ft; 2 = 2,000ft)
3. The precise arrangement of marker boards varies according to the aerodrome and a note on the landing chart will explain any difference from the layout shown below.




**Note 1**: At runway/taxiway intersections where the centreline is curved towards onto the nearside of the runway centreline, pilots should take account where appropriate of any loss of *'Runway Declared Distances'* incurred in following the lead-on line whilst lining up for take-off.

**Note 2**: At major aerodromes in the UK taxiway width is determined so as to ensure a specified minimum clearance between the taxiway edge and the main undercarriage outer wheels of the largest aircraft that the taxiway is designed to accommodate. The minimum wheel clearance is assured in turns provided that the pilot keeps a flight-deck point over the taxiway centreline.

### 1.8.3 Secondary Power Supply

Secondary power supply with a switch-over time of 1 second for the Visual Aids will be provided in accordance with the requirements of *ICAO Annex 14*. Any failure of the secondary power supply equipment will result in a down-grading of ILS Operations, as declared by ATC.

## 1.9 NON-VISUAL AIDS

### Equipment

ILS ground equipment serving instrument runways must have no-break power supplied by dual systems located and operated according to *ICAO Annex 10, Volume 1 Standards and Recommended Practices.* Automatic monitor systems according to the requirements of *Annex 10, Volume 1, Part 1,* are to be provided for all ILS ground systems components. Localizers (LLZ) certified for Cat 2 and/or Cat 3 operations are to be additionally monitored by a far-field monitor. Pilots will be informed without delay of any deficiency. In addition, Flight inspections of the ILS approach equipment shall be conducted at regular intervals according to *ICAO Document 8071* guidelines.

### 1.10 ILS SENSITIVE AREAS

A sensitive area for localizer protection must be established.

a. For ATC purposes, the LLZ sensitive area is defined as a rectangular area which is located within parallel lines, 150m from the runway centre line on both sides, between the localizer aerial and the beginning of the runway.

b. During Cat 2 and Cat 3 operations, the ILS sensitive area must be kept clear of all vehicles and aircraft, at all times from when an approaching aircraft is 2 nm from the threshold until it has completed its landing run and, at all times that an aircraft takes-off using the ILS localizer for guidance during the take-off run.

#### 1.10.1 Secondary Power Supply

All radio navigation aids, essential communication equipment and the RVR assessment system must be supplied with ‘no-break’ power.

### 1.11 SERVICES AT AERODROMES

a. **Aerodrome services**

Maintenance and inspection of the visual aids, runways and taxiways must be carried out at regular intervals by the aerodrome operator. Maintenance and inspection of visual and non-visual aids must be carried out by a specialist calibration unit.

b. **Aeronautical Information Services**

Under normal circumstances, pilots must expect that facilities provided for all-weather operations to the particular runway are operative. Any change in operational status or any other deficiency, if caused by a failure expected to last more than one hour, will be promulgated by NOTAM; pilots will be informed accordingly by ATC and/or via the ATIS.

c. **Meteorological Service**

Accurate and timely reporting of meteorological conditions according to *ICAO Annex 3* must be provided at the aerodrome concerned.

Runway Visual Range (RVR) is normally assessed by electronic transmissometers whose position must be abeam the touch-down zone, mid-point and stop-end of instrument runways.

d. **Airport Fire & Rescue Services**

An airport designed for all weather operations should have a fully operational Fire and Rescue Service capable of operating in CAT III operations**.** (ICAO annex 14)

### 1.12 REQUIREMENTS FOR AIRCRAFT AND FLIGHT CREW

a**.** **Aircraft and Equipment**

Basic requirements for an aircraft and its equipment for Cat 2 and Cat 3 operations are described in *ICAO Doc. 9365-AN/10 - Manual of All Weather Operations*.

b. **Flight Crews**

Training and experience requirements for flight crews to operate at low minima are described in *ICAO Doc. 9365-AN/10 - Manual of All Weather Operations*.

#### 1.12.1 FLIGHT TRAINING AND PRACTICE APPROACH

Training flights simulating low minima approaches must be announced on initial contact with “Approach control” using the phrase "REQUEST PRACTICE Cat 2 or Cat 3". Depending on the traffic situation, permission will be granted whenever possible. LVO Procedures will only be applied if traffic permits. Departing or preceding landing traffic may disturb ILS signals. Under weather conditions better than Cat 2 and Cat 3, the secondary power supply will not be operated for the visual approach aids prescribed for Cat 2 and Cat 3 operations.

### 1.13 AUTHORISATION FOR CAT 2 AND CAT 3 OPERATIONS

a. **Domestic Operations**

ALL aircraft owners and operators wanting to carry out domestic Cat 2 and Cat 3 operations shall apply in writing to the Local State NAA, for permission to carry out such operations in its airspace; and also to the State of aircraft Registry if different.

b. **Foreign Operations**

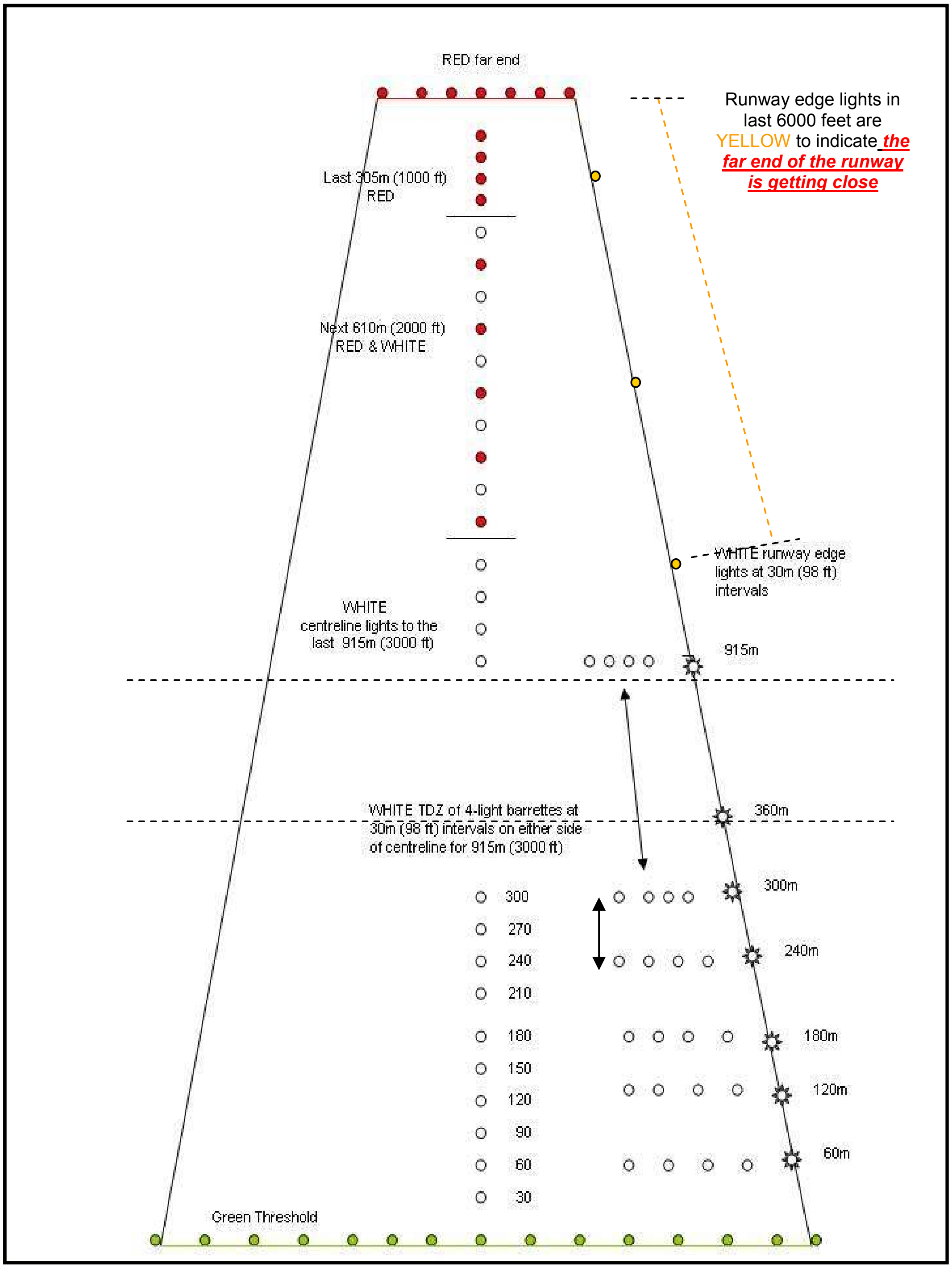
For All Weather Operations at destinations outside a State, aircraft owners and operators must ask the destination State NAA for the necessary All Weather Operations Permit. A permit for LVO at a ‘foreign’ destination will be granted by the Local NAA only after submitting a copy of the AWO Approval given by the State of AOC-issue for Commercial Air Transport operators ***and*** the State of Registry if different; and by the State of Registry.

## SECTION 2 - ILLUSTRATIONS

### 2.1 CALVERT Cat 2 & Cat 3 RUNWAY LIGHTING

2.1.1 **Runway lights diagram with TDZ carpet lighting and far-end colour-coded centreline lights at 30m spacing in this installation. The last 3000 ft centre-lights are coded red/white, turning to red for the last 1000 ft.**

**Note that the last 6000 feet of Runway-edge lighting is YELLOW**



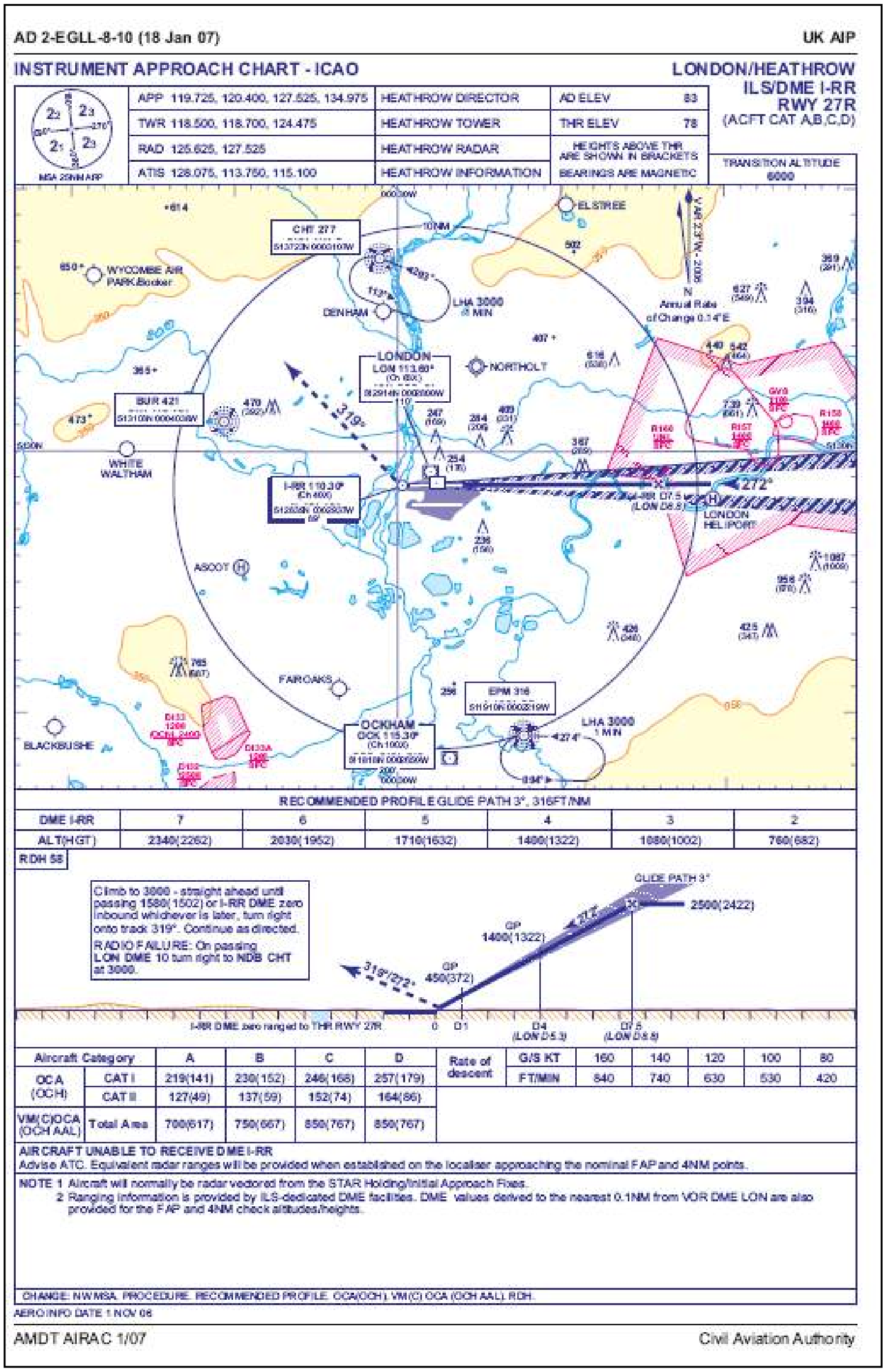



**Runway not to scale** – Only the first 915m (3,000ft) and last 1,830m (6,000ft) of runway lighting is shown. The White flush-mounted TDZ carpet barrettes are spaced at 60m with centre and edge lighting at 30m intervals. Middle segment (not shown) has white runway-edge lights & white centre-line lighting, all at 30m intervals.

## 2.2 SAMPLE LET-DOWN PLATES & AIRFIELD SURFACE CHARTS

### 2.2.1 London (Heathrow) Runway 27R ILS OCAs (UK AIP)

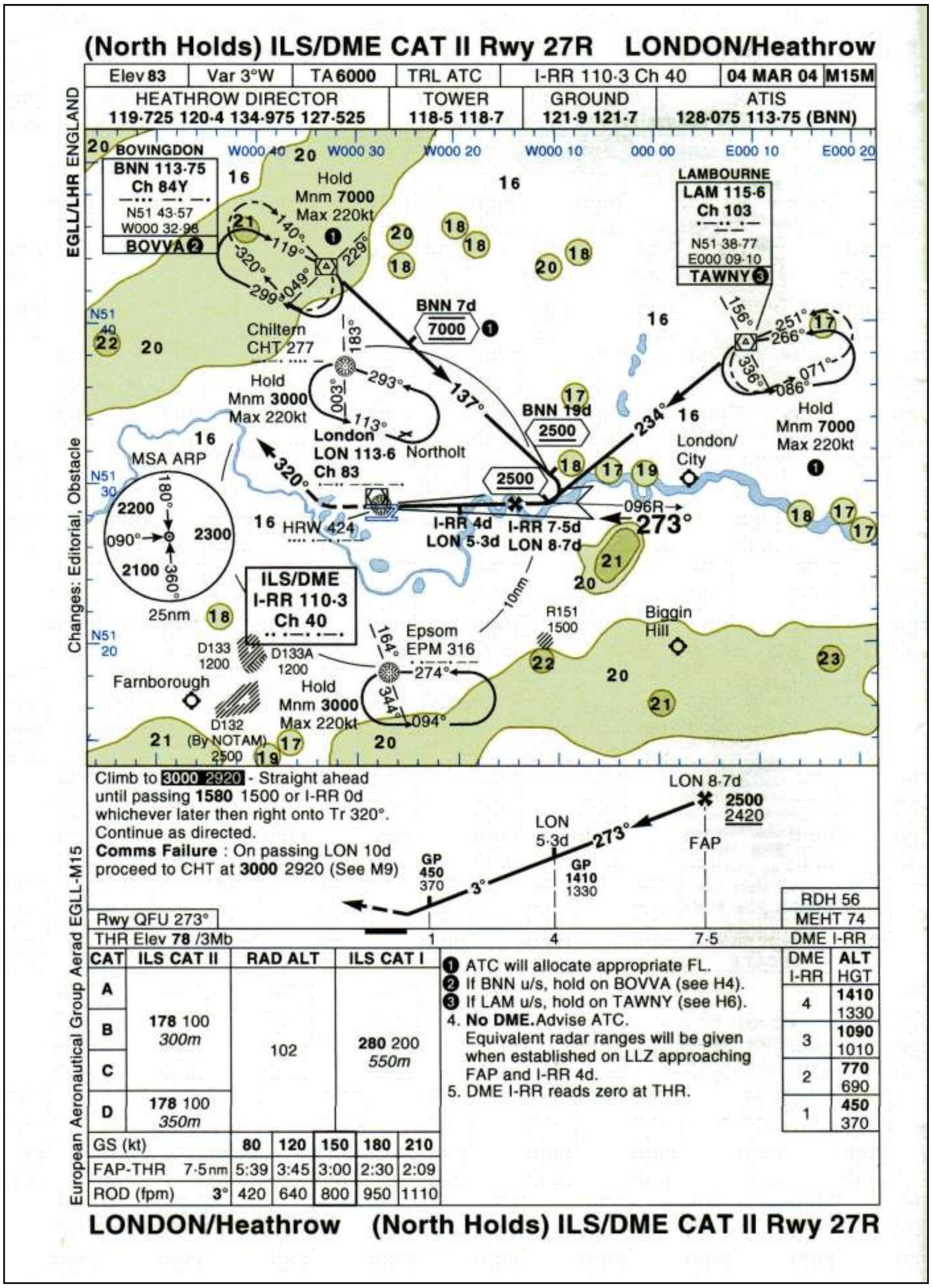
NOT FOR OPERATIONAL USE




UK CAA let-down plate for the London Heathrow 27R ILS, taken from the UK AIP (Air Pilot). Note that it ONLY shows Obstacle Clearance data (OCA/H), from which are derived the appropriate AOM. It shows danger areas and spot heights only, leaving the pilot to work out his Minimum Safe Altitude inside the 25 n.miles radius, as addressed in the top left hand corner of the plate.

2.2.2 **London (Heathrow) Runway 27R ILSC2 (AERAD) Let-down Plate**

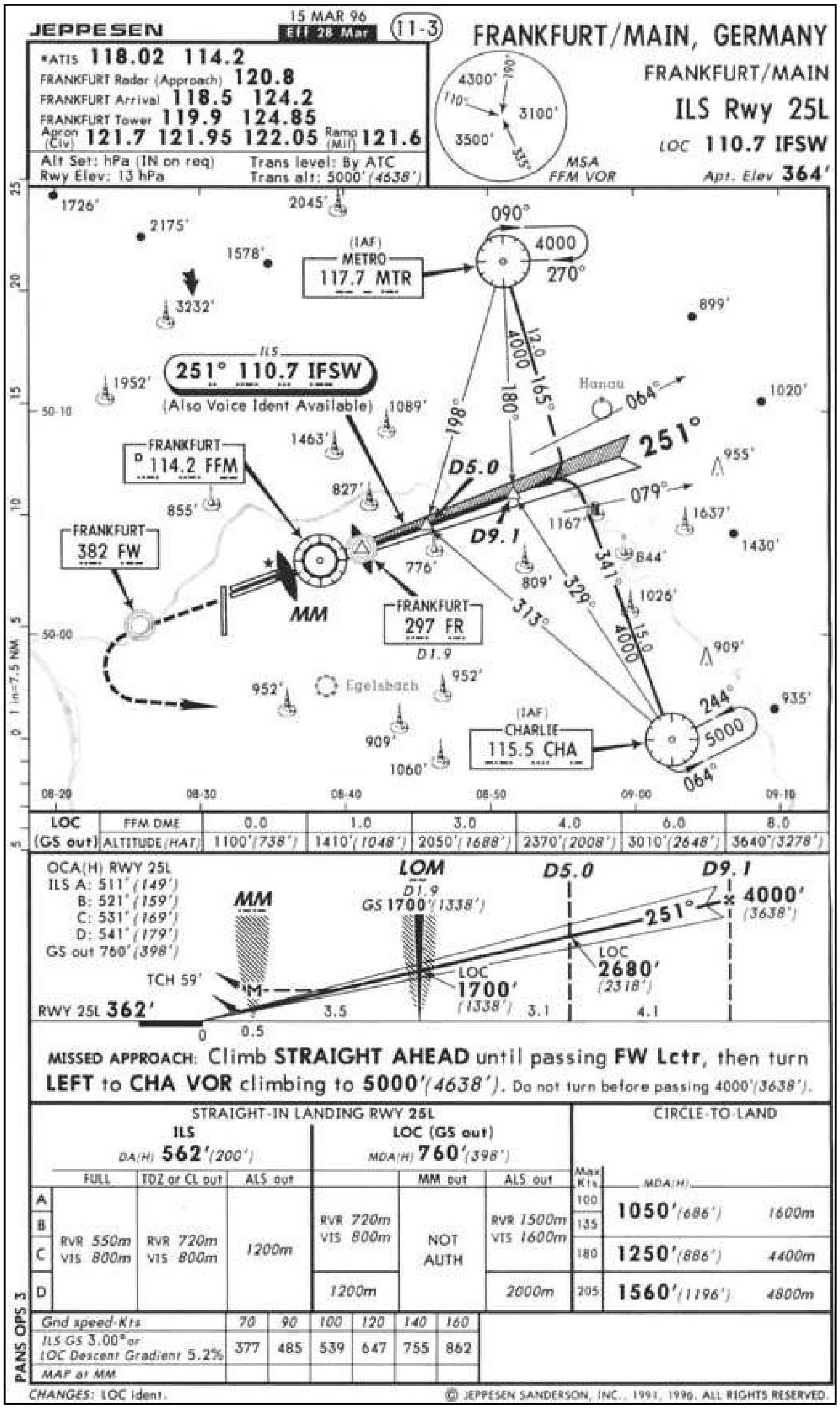
NOT FOR OPERATIONAL USE




For comparison, this European Aeronautical Group ‘Aerad’ plate produced for British Airways for the 27R ILS from data provided by the NAA, (in this case the UK CAA), includes AOM for Cat 1 & at Cat 2 approaches, Go-around instructions and Minimum Safe Altitude contours within 10 n.miles, in varying shades of **Green,** instead of terrain elevation spot heights and/or contour lines. AOM are offered below the let-down information on the plate.

### 2.2.3 Frankfurt / Main Runway 25L ILS (Jeppesen) Let-down Plate

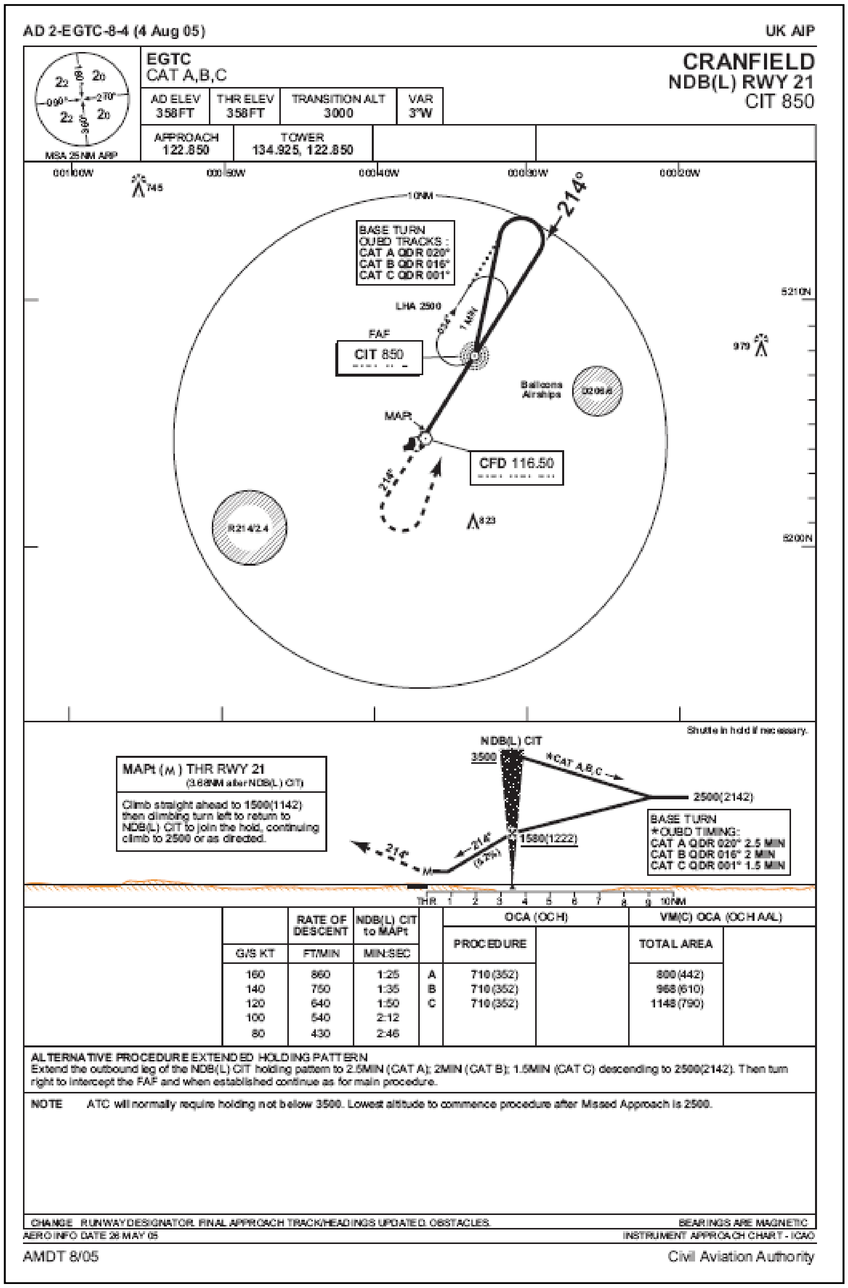
NOT FOR OPERATIONAL USE




ILS let down plate Produced by Jeppesen Inc from data provided by the German NAA (LBA). Note the inclusion of AOM and Missed Approach instructions with spot heights to mark terrain elevations.

### 2.2.4 Cranfield Runway 21 NDB (UK AIP) Let-down Plate

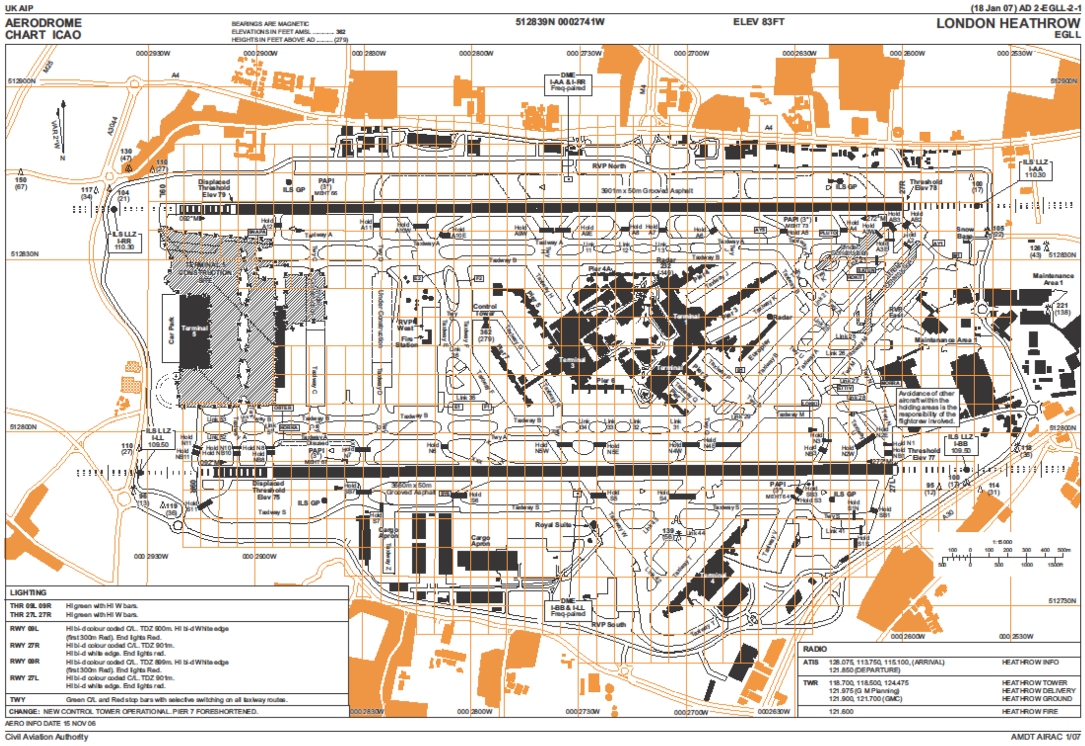
NOT FOR OPERATIONAL USE




UK CAA let down plate for the Cranfield (England) NDB let down with danger areas to be avoided and the odd spot height, with terrain undulations shown on the elevation cross-section view. This NDB let down is not typical of the usual single NDB set at about 5 n.miles on the approach, leaving the pilot to work out his descent; depending on the groundspeed and rate of descent, against time from overhead. In this case a second Locator beacon is on the airfield to assist lining-up by looking at the needle pointing ahead, rather than using a back-bearing. No AOM information is offered but OCH/A data is given instead, from which AOM can be self calculated or provided by proprietary producers of Let-down plates for the use of purchasers of their services.

2.2.5 **London (Heathrow) Airport Surface Chart (UK AIP)**

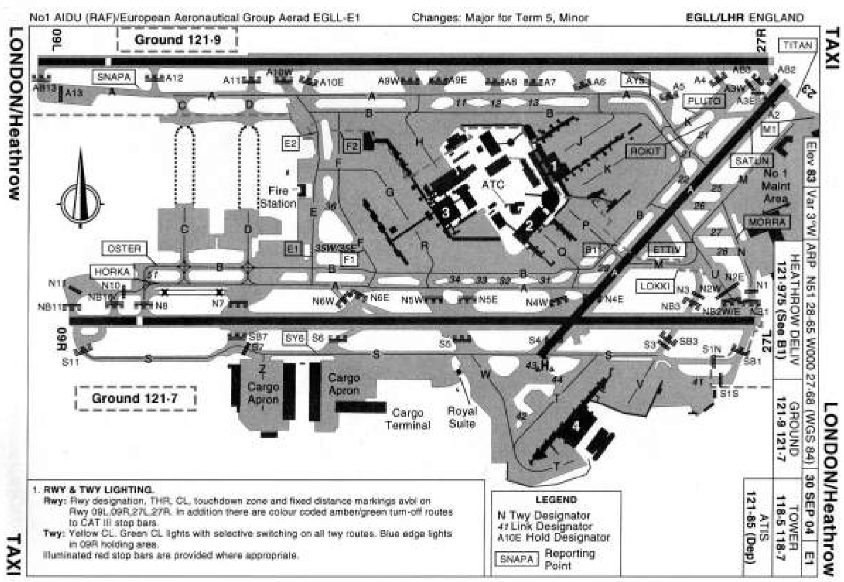
SAMPLE - NOT FOR OPERATIONAL USE




To illustrate the concept of combined DME installations serving both ends of the same runway, this is the London Heathrow Aerodrome Chart produced by the CAA for the UK AIP. It shows the position of the I-BB & ILL and I-AA & IRR Frequency-paired DME transmitters which are located approximately midway from each end of 27R/09L (to the North of) and 27L/09R (to the South of) that serve whichever ILS is selected on the flight-deck of an approaching aircraft. They are calibrated to show ZERO as the aircraft crosses the threshold of the runway served by the tuned ILS.

2.2.6 **Sample Ground Movements Chart for use when taxiing**

NOT FOR OPERATIONAL USE




**Courtesy of No1 AIDU- (RAF) & European Aeronautical Group (Aerad)**

**London Heathrow at dawn …**


© Captain Philip 'Phil' H.S. SMITH, MRAeS

**'Cu Nim' to avoid …** © Captain Philip 'Phil' H.S. SMITH, MRAeS

**END OF APPENDIX F - AIRPORTS,**

**APPENDIX G - DOCUMENTS**

**DOCUMENTS TO BE CARRIED OR LEFT ON THE GROUND AND PRESERVED OR PRODUCED ON DEMAND**

**EASA OPS 1 - Commercial Air Transport – Operational Requirements Extract**

***OPS 1.125*** **Documents to be carried**

(a) An operator shall ensure that the following documents or copies thereof are carried on each flight:
- (1) The Certificate of Registration;
- (2) The Certificate of Airworthiness;
- (3) The original or a copy of the Noise Certificate (if applicable), including an English translation, where one has been provided by the Authority responsible for issuing the noise certificate;
- (4) The original or a copy of the Air Operator Certificate;
- (5) The Aircraft Radio Licence; and
- (6) The original or a copy of the Third party liability Insurance Certificate(s).

(b) Each flight crew member shall, on each flight, carry a valid flight crew licence with appropriate rating(s) for the purpose of the flight and include a valid medical certificate, showing any limitations applied. E.g. Requirement for spectacles, with spare pair carried.

***OPS 1.130*** **Manuals to be carried**

a. An operator shall ensure that:

- (1) The current parts of the Operations Manual relevant to the duties of the crew are carried on each flight;
- (2) Those parts of the Operations Manual which are required for the conduct of a flight are easily accessible to the crew on board the aeroplane; and 12.1.2008 EN Official Journal of the European Union L 10/11
- (3) The current Aeroplane Flight Manual is carried in the aeroplane unless the Authority has accepted that the Operations Manual prescribed in OPS 1.1045, Appendix 1, Part B contains relevant information for that aeroplane.

***OPS 1.135*** **Additional information and forms to be carried**

(a) An operator shall ensure that, in addition to the documents and manuals prescribed in OPS 1.125 and OPS 1.130, the following information and forms, relevant to the type and area of operation, are carried on each flight:
- (1) Operational Flight Plan containing at least the information required in OPS 1.1060;
- (2) Aeroplane Technical Log containing at least the information required in Part M, paragraph M. A. 306 Operator's technical log system;
- (3) Details of the filed ATS flight plan;
- (4) Appropriate NOTAM/AIS briefing documentation;
- (5) Appropriate meteorological information;
- (6) Mass and balance documentation as specified in Subpart J;
- (7) Notification of special categories of passenger such as security personnel, if not considered as crew, handicapped persons, inadmissible passengers, deportees and persons in custody;
- (8) Notification of special loads including dangerous goods including written information to the commander as prescribed in OPS 1.1215 (c);
- (9) Current maps and charts and associated documents as prescribed in OPS 1.290 (b)(7);
- (10) Any other documentation which may be required by the States concerned with this flight, such as cargo manifest, passenger manifest etc; and
- (11) Forms to comply with the reporting requirements of the Authority and the operator.

(b) The Authority may permit the information detailed in subparagraph (a) above, or parts thereof, to be presented in a form other than on printed paper. An acceptable standard of accessibility, usability and reliability must be assured.

***OPS 1.140*** **Information retained on the ground**

(a) An operator shall ensure that, at least for the duration of each flight or series of flights;
- (1) Information relevant to the flight and appropriate for the type of operation is preserved on the ground; and
- (2) The information is retained until it has been duplicated at the place at which it will be stored in accordance with OPS 1.1065; or, if this is impracticable,
- (3) The same information is carried in a fireproof container in the aeroplane.

(b) The information referred to in subparagraph (a) above includes:

(1) A copy of the operational flight plan where appropriate;

(2) Copies of the relevant part(s) of the aeroplane technical log;

(3) Route specific NOTAM documentation if specifically edited by the operator;

(4) Mass and balance documentation if required (OPS 1.625 refers); and

(5) Special loads notification.

***OPS 1.150*** **Production of documentation and records**

(a) An operator shall:

(1) Give any person authorised by the Authority access to any documents and records which are related to flight operations or maintenance; and

(2) Produce all such documents and records, when requested to do so by the Authority, within a reasonable period of time.

(b) The commander shall, within a reasonable time of being requested to do so by a person authorised by an Authority, produce to that person the documentation required to be carried on board.

***OPS 1.155*** - **Preservation of documentation**

An operator shall ensure that:

(1) Any original documentation, or copies thereof, that he is required to preserve is preserved for the required retention period, even if he ceases to be the operator of the aeroplane; and

(2) Where a crew member, in respect of whom an operator has kept flight duty, duty and rest period records, becomes a crew member for another operator, that record is made available to the new operator.

***OPS 1.160*** **- Preservation, production and use of flight recorder recordings**

(a) Preservation of recordings:

(1) Following an accident, the operator of an aeroplane on which a flight recorder is carried shall, to the extent possible, preserve the original recorded data pertaining to that accident, as retained by the recorder for a period of 60 days unless otherwise directed by the investigating authority.

(2) Unless prior permission has been granted by the Authority, following an incident that is subject to mandatory reporting, the operator of an aeroplane on which a flight recorder is carried shall, to the extent possible, preserve the original recorded data pertaining to that incident, as retained by the recorder for a period of 60 days unless otherwise directed by the investigating authority.

(3) Additionally, when the Authority so directs, the operator of an aeroplane on which a flight recorder is carried shall preserve the original recorded data for a period of 60 days unless otherwise directed by the investigating authority.

(4) When a flight data recorder is required to be carried aboard an aeroplane, the operator of that aeroplane shall:

(i) Save the recordings for the period of operating time as required by OPS 1.715, 1.720 and 1.725 except that, for the purpose of testing and maintaining flight data recorders, up to one hour of the oldest recorded material at the time of testing may be erased; and

(ii) Keep a document which presents the information necessary to retrieve and convert the stored data into engineering units.

(b) Production of recordings

The operator of an aeroplane on which a flight recorder is carried shall, within a reasonable time after being requested to do so by the Authority, produce any recording made by a flight recorder which is available or has been preserved.

(c) Use of recordings:

(1) The cockpit voice recorder recordings may not be used for purposes other than for the investigation of an accident or incident subject to mandatory reporting except with the consent of all crew members concerned.

(2) The flight data recorder recordings may not be used for purposes other than for the investigation of an accident or incident subject to mandatory reporting except when such records are:

(i) Used by the operator for airworthiness or maintenance purposes only; or

(ii) De-identified; or

(iii) Disclosed under secure procedures.

**OPERATIONS MANUAL**

**Example of colour-coded and bar-coded operations manual volumes, for ease of visual identification (With a Fleet Logo within a geometric shape, to ensure placing on the correct aircraft type)**

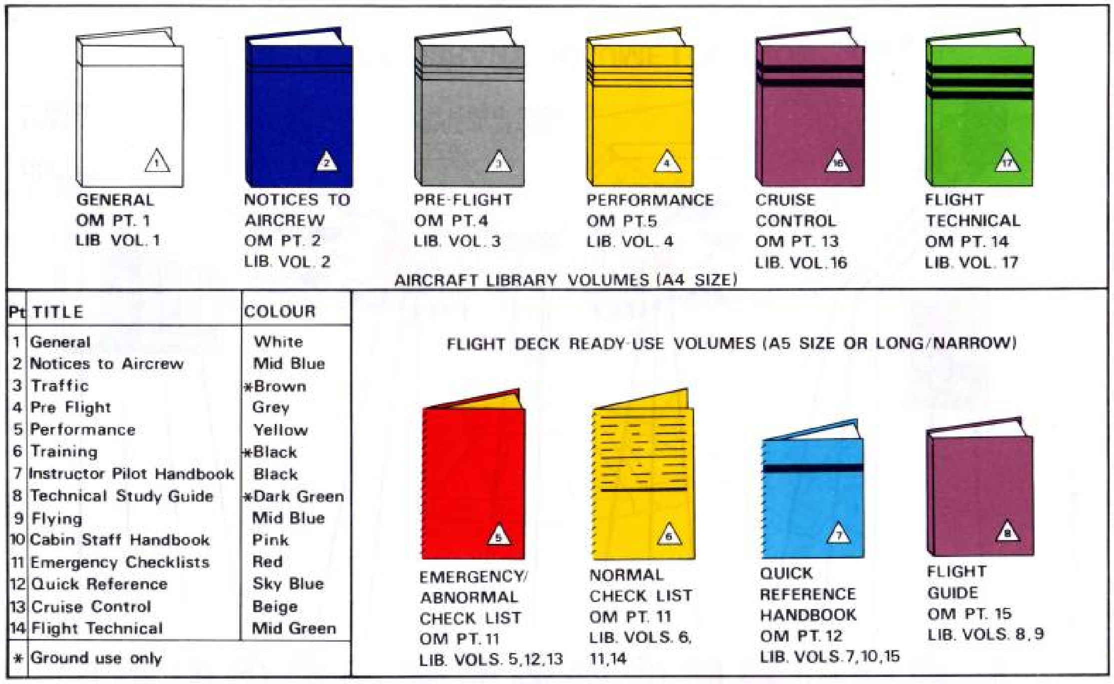



**Figure 1**

An old idea revisited … as useful for ease of identification of a specific subject volume & the retrieval of information.

Figure 1 and Figure 2 are graphics from UK CAA CAP 450 (1988), now out of print. CAP 450 was the predecessor of current guidance on operations manuals contents requirements. It was written by Captain Ralph Kohn FRAeS for the CAA, in 1988.

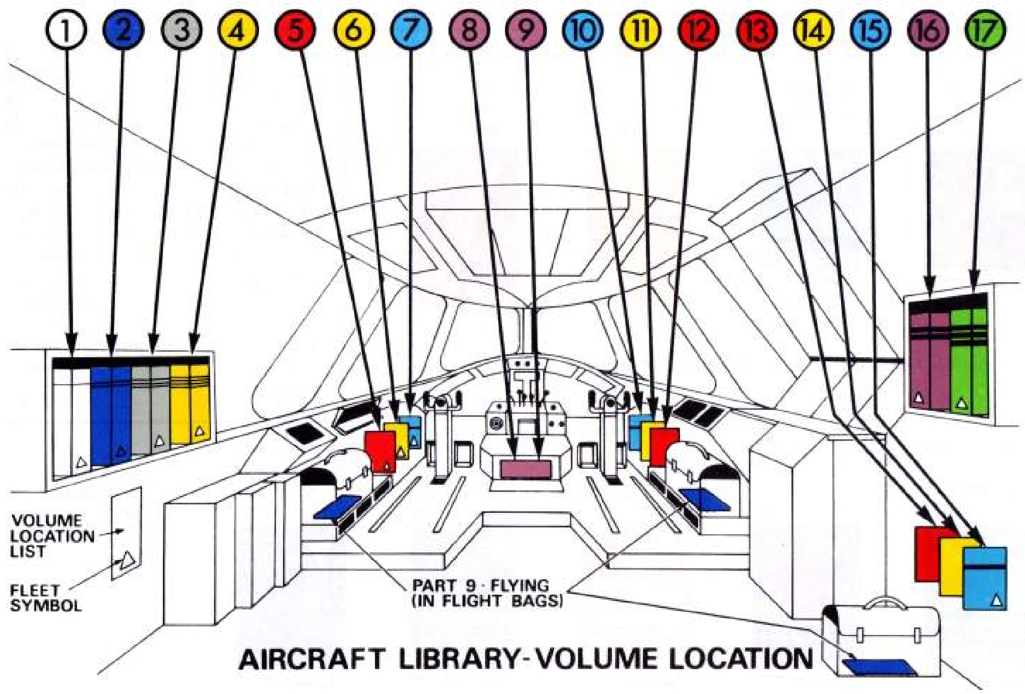



**Figure 2**

| *Aircraft Library Volume Number Location Number or Title (within the fleet symbol)* | *Part Number* | Title |
|---|---|---|
| 1 | 1 | General |
| 2 | 2 | Notices to Aircrew |
| 3 | 4 | Pre Flight |
| 4 | 5 | Performance |
| 5 | 11 | Emergency/Abnormal checklist |
| 6 | 11 | Normal checklist |
| 7 | 12 | Quick Reference Handbook |
| 8 | 15 | Flight Guide |
| 9 | 15 | Flight Guide |
| 10 | 12 | Quick Reference Handbook |
| 11 | 11 | Normal checklist |
| 12 | 11 | Emergency/Abnormal checklist |
| 13 | 11 | Emergency/Abnormal checklist |
| 14 | 11 | Quick Reference Handbook |
| 15 | 12 | Normal Checklist |
| 16 | 13 | Cruise Control |
| 17 | 14 | Flight Technical |

The location numbers refer to the aircraft library volume assigned stowage as illustrated in Figure 2
The following list is a guide to the location of Operations Manual volumes that are NOT included in the aircraft library

| *Volume* | *Title* | *Location* |
|---|---|---|
| 3 | Traffic, or Ground Operations | ON GROUND in Traffic office |
| 6 | Training | ON GROUND with training staff |
| 7 | Instructor Pilot Handbook | IN BRIEF CASE/FLIGHT BAG |
| 8 | Technical Study Guide | ON GROUND at home |
| 9 | Flying | IN BRIEF CASE/FLIGHT BAG |
| 10 | Cabin Staff Handbook | IN HANDBAG/FLIGHT BAG |

**END OF APPENDIX G - DOCUMENTS**

## APPENDIX H - BIBLIOGRAPHY

### 1. Normal Operations

**EU OPS1**: (11 December 2007) Commercial Air Transportation (Aeroplanes)

***ANNEX III -*** Common technical requirements and administrative procedures applicable to commercial transportation by aircraft (see Official Journal of the European Union, 12.1.2008 edition)

**The Air Navigation (Dangerous Goods) Regulations 2002**

- Part V - Commander's Obligations
- Section 12 - Commander's duty to inform air traffic services

**CAP 382 :** Mandatory Occurrence Reporting Scheme

**CAP 413 :** Radiotelephony Manual

**CAP 459** : Minimum Equipment Lists

Also see ***A Guide to Information Sources for Preparing a Minimum Equipment List.*** This can be found on the CAA website www.caa.co.uk/publications where MMELs for various aircraft types are also offered.

### 2. AAIB - The investigation process relating to general aviation accidents:

Gen Aviation Leaflet.pdf (171.92 kb)
The investigation process relating to commercial air transport major disasters, accidents and serious incidents:

Pub Transport Leaflet.pdf (97.99 kb)
Guidance for Police and the Emergency Services

Guidance for Police and the Emergency Services (90.66 kb)
Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996:

**http://www.legislation.hmso.gov.uk/si/si1996/Uksi_19962798_en_1.htm** (link opens in new window)
The Civil Aviation (Investigation of Military Air Accidents at Civil Aerodromes) Regulations 2005:

### 3. AAIB - Publications

Formal reports: These are reports of Inspectors Investigations relating to specific accidents or serious incidents.

Bulletins: A monthly publication of accidents and serious incidents.

Special Bulletins: Bulletins detailing the initial facts after a major accident.

Progress Reports: Annual Report on AAIB Safety Recommendations

Foreign Reports: Reports published by foreign accident investigation

### 4. ICAO New Noise Abatement Rules

ICAO state letter – amendment 15 to Pans-Ops 5$^{th}$ edition volume 1 (See Part 3, Section 22)

### 5. CAA/NATS DVD (Computer Disc): Communications Errors and Level Busts

Copy from NATS Corporate & Technical centre on request to e-mail : karen.skinner@nats.co.uk

Mail: Mailbox 11, 4000 Parkway, Whiteley, Fareham, Hampshire (PO15 7FL)
Telephone: 07966 465 785
Website: **www.nats.co.uk**

### 6. COMMAND UPGRADE THOUGHTS by Captain Grant 'Jack' Frost (Cathay Pacific)

(A collection of *'must read'* useful thoughts and views presented on an Internet 'Blog' site).

Command does not begin when you start your formal Upgrade training, it starts many months beforehand when you make the conscious decision to BE THE CAPTAIN and start to mentally prepare to take on your new role. This mental transformation is what this ‘blog’ is all about – it is the key idea. If I achieve nothing else and if you think most of what I write is rubbish, but you change your ATTITUDE and your MIND-SET to BE THE CAPTAIN … well then, I think I've achieved my main aim of this whole enterprise!

**Always remember: *The most important airspace is the six inches between your ears*.**

**MIND-SET**
**ATTITUDE**
**BE THE CAPTAIN**

***Work on it right NOW!***

Blog site: **http://airline-command.blogspot.com/**
E-mail: **airline.command@gmail.com**

## 7. NATIONAL AEROSPACE LIBRARY

The National Aerospace Library at Farnborough houses one of the world’s most extensive research libraries devoted to the development of aeronautics, aviation and aircraft/aerospace technology from the dawn of flight to present times.

Located at Farnborough IQ Business Park in the former Royal Aircraft Establishment building now known as ‘The Hub’, available to view at the National Aerospace Library are:
- Over 20,000 aeronautical books
- Many 1,000s of back-issues over the decades of key aviation journals from around the world, many of these titles held as bound runs for reference
- Over 40,000 technical reports from aeronautical research establishments from around the world from 1909 onwards including AGARD/ARC/ARL/DLR/ESA/ESRO/FFA/ISAS/NACA/NASA/NLR/NRC/ONERA/TAE/UTIAS and some of the major Royal Aircraft Establishment (RAE) technical report series.
- Extensive holdings of Air Publications, ATA handling notes and air accident reports
- Extensive current holdings of International Civil Aviation Organization (ICAO) Documents/Annexes/Circulars
- Notices to Airmen/The Air Pilot/UK Aeronautical Information Publication (AIP) from the 1920s through to 1999/The UK Topographical Air Charts from the mid-1950s
- A complete set of *Jane’s All the World’s Aircraft* plus other volumes from the ‘Jane’s’ series
- Historically important past minutes of the Society of British Aircraft Constructors/Aerospace Companies [SBAC] Council and its various committees dating from 1916-2000
- Library staff are available to assist enquirers
- The Library's extensive online database catalogue of over 90,000 records searchable via the website: www.aerosociety.com/nal

The fully licensed café bar - Aviators Café Bar - is located close by on the same ground floor level as the Library.

There are a number of allocated car parking spaces for the National Aerospace Library in O’Gorman Avenue which runs along the back of the Library. The nearest railway station Farnborough (Main) is a short taxi ride away.

For more information on The National Aerospace Library - which is open Tuesday-Friday 10 am to 4 pm - and the material held there, please contact the librarians: E-mail: **hublibrary@aerosociety.com.**

Reception area

**NATIONAL AEROSPACE LIBRARY**

**The Hub**
**Fowler Avenue**
**IQ Farnborough**
**Hampshire**
**GU14 7JP, UK**

Tel: +44 (0)1252 701 038 or
+44 (0)1252 701 060

**END OF APPENDIX H**
**BIBLIOGRAPHY**

## APPENDIX I - USEFUL ADDRESSES

**For calls from overseas, dial 00 (or the international access code from the place you are in) + 44 then drop the first digit 0 in brackets shown as such (0), then enter the rest of the number listed. When in the United Kingdom, dial the number exactly as shown.**

### AIR ACCIDENTS INVESTIGATION BRANCH (AAIB) (UK)

The UK Air Accidents Investigation Branch (AAIB) is part of the Department for Transport and is responsible for the investigation of civil aircraft accidents and serious incidents within the UK.

Air Accidents Investigation Branch
Berkshire Copse Road
Aldershot
Hampshire
GU11 2HH

Tel: 01252 510 300
Fax: 01252 376 999
E-mail: **enquiries@aaib.gov.uk**
Website: **http:// www.aaib.dft.gov.uk**

For all official requests for technical assistance please contact us by fax on number +44 (0)1252 376 999

**AAIB Links**

Please note that all links open in a new window.

**UK Sites**
UK - Airprox Board (UKAB)
UK - British Gliding Association (BGA)
UK - BGA Gliding Accidents Reports (User name: user, Password: risingmoon)
UK - British Hang Gliding and Paragliding Association
UK - British Microlight Aircraft Association
UK - British Helicopter Advisory Board
UK - Civil Aviation Authority (CAA)
UK - Civil Aviation Authority (CAA) - Responses to AAIB Safety Recommendations
UK - Confidential Human Factors Incident Reporting Programme (CHIRP)
UK - Defence Aviation Safety Centre
UK - Flight Safety Committee (UKFSC)
UK - NATS - Aeronautical Information Service (AIS)

---

### CIVIL AVIATION AUTHORITY (UK)

**Civil Aviation Authority Headquarters**
CAA House
45-59 Kingsway
London
WC2B 6TE
T: 020 7379 7311 (This telephone number can also be used for all out of hours emergencies)

**CAA Departments** (in Alphabetical order)

**Airspace Policy Directorate**
CAA House
45-59 Kingsway
London
WC2B 6TE
T: 020 7453 6599
F: 020 7453 6593

**Air Traffic Services Licensing: -** 01293 573355 or, by e-mail at: **ats.licensing@srg.caa.co.uk**

**Consumer Protection Group**
CAA House
45-59 Kingsway
London
WC2B 6TE
T: 020 7453 6430
F: 020 7453 6431

Directorate of Airspace Policy
CAA House
45-59 Kingsway
London
WC2B 6TE
T: 020 7453 6599
F: 020 7453 6593

**Economic Regulation Group**
CAA House
45-59 Kingsway
London
WC2B 6TE
T: 020 7453 6213
F: 020 7453 6244

**Human Resources (HR) Department -** *For job opportunities in the Economic Regulation Group, Consumer Protection Group, Directorate of Airspace Policy or Corporate Departments, contact :-*

**Civil Aviation Authority HR Department - London Team**
Room 216
CAA House
45-59 Kingsway
London
WC2B 6TE
T: 020 7453 6040
F: 020 7453 6045

**Human Resources (HR) Department:** *For job opportunities in the Safety Regulation Group, contact*
**Civil Aviation Authority HR Department - Gatwick Team**
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR
T: 01293 567171 (This telephone number can be used for all out of hours emergencies)
F: 01293 573940

**Library and Information Centre**
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

Telephone: 01293 573725
Fax: 01293 573181
Email: **library-enquiries@srg.caa.co.uk**
Website: **http://www.caa.co.uk/library**

**Medical Department:** 01293 573700 or by e-mail to: **medicalweb@srg.caa.co.uk**

**Personnel Licensing and Medicals: -** Enquiries should be made to the following:-

**Personnel Licensing Department:** 01293 573700 or by e-mail**:** **fclweb@srg.caa.co.uk or eldweb@srg.caa.co.uk**
If you have not be able find the information you require from the web site and you would like further assistance please contact the CAA Enquiry Team: 01293 57 3725 or by e-mail: **infoservices@caa.co.uk**

**Publications** (to purchase CAA documentation)
Documedia Solutions Ltd.
37 Windsor Street
Cheltenham
Gloucestershire
GL 2DG
Telephone: 01242 283100
Fax: 01242 283131
E-mail: **sales@documedia.co.uk**
Website: **http://www.documedia.co.uk**

**Safety Regulation Group**
Civil Aviation Authority
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR
T: 01293 567171 (This telephone number can be used for all out of hours emergencies)
F: 01293 573940

---

**EASA - EUROPEAN AVIATION SAFETY AGENCY**

Contacting the EASA
The Agency moved on 3rd November 2004 to its final headquarters in Cologne.

New address in Cologne:
Postal address for letters only
European Aviation Safety Agency
Postfach 10 12 53
D-50452 Köln, Germany

Switchboard:
+49 221 8999 000
+49 221 8999 0000
+49 221 8999 00000

General fax:
+ 49 221 8999 099
+ 49 221 8999 0999
+ 49 221 8999 09999

Postal address for parcels and other larger consignments

Visitors' address
European Aviation Safety Agency
Ottoplatz, 1
D-50679 Köln, Germany

Please note that only letters should be sent to the **Postfach 10 12 53** address. Parcels and larger consignments should be sent to the **Ottoplatz** address.

Website:: **http://www.easa.eu.int.**

---

**HM STATIONERY OFFICE – Publishers of all UK Legislation Documents**

**Her Majesty's Stationery Office (HMSO)**

Her Majesty's Stationery Office (HMSO) continues to exist and fulfill its core activities, including responsibility for the publication of legislation and the management of Crown copyright operating from within the Office of Public Sector Information (OPSI). For more information on OPSI and HMSO please see the Related Pages menu on the OPSI website at **http://www.opsi.gov.uk/**

The Office of Public Sector Information does not sell legislation or any other official publications. To buy copies of legislation or any other former HMSO publications please contact The Stationery Office Ltd (TSO).

**The Stationery Office Ltd (TSO)**
For information on the services offered please visit the TSO website on http://**www.tso.co.uk**
Personal shoppers may purchase publications at the following retail shops

**Belfast**
TSO
16 Arthur Street
Belfast BT1 4GD
Tel: 02890 238451
Fax: 02890 235401
E-mail**: belfast.bookshop@tso.co.uk**

Edinburgh
TSO Scotland Bookshop
71 Lothian Road
Edinburgh EH3 9AZ
Tel: 0870 606 5566
Fax: 0870 606 5588
E-mail: **edinburgh.bookshop@tso.co.uk**

**London**
TSO
123 Kingsway
London WC2B 6PQ
Tel: 020 7242 6393 or 020 7242 6410
Fax: 020 7242 6394
E-mail: **london.bookshop@tso.co.uk**

**Your order**
If you find you are having difficulty placing an order or if there is a problem with an order you have already placed, contact Customer Services by email at: **esupport@tso.co.uk** or, telephone +44 (0)870 242 2345**.**

---

**AVIATION-RELATED GUILDS, SOCIETIES AND PILOT REPRESENTATIVE ORGANISATIONS IN THE UK**

**The Royal Aeronautical Society**
4 Hamilton Place
London
W1J 7BQ
Tel: +44(0)20 7670 4300
Fax +44(0)20 7670 4309
E-mail: **raes@aerosociety.com**
Website: **http://www.aerosociety.com**

**The Guild of Air Pilots & Air Navigators (GAPAN)**
Cobham House
9 Warwick Court
Gray's Inn
London
WC1 R 5DJ
United Kingdom
Tel: +44(0)20 7404 4032
Fax +44(0)20 7670 4035
E-mail: **gapan@gapan.org**
Website: **http://www.gapan.org**

**The British Air Line Pilots Association (BALPA)**
BALPA House
5 Heathrow Boulevard
278 Bath Road
West Drayton
UB7 0DQ
Tel: +44(0)20 8746 4000
Fax:+44(0)20 8746 4077
E-mail: **balpa@balpa.org**
Website: **http://www.balpa.org**

**The British Helicopter association (BHA)**
Graham Suite
West Entrance
Fairoaks Airport
Chobham
Woking
Surrey
GU24 8HX
Tel: +44 (0) 1276 856100
Fax:+44 (0) 1276 856126
E-mail: **info@britishhelicopterassociation.org**
Website: http://www.**britishhelicopterassociation**.org

**The Independent Pilots' Association (IPA)**
The Old Refectory
The Priory
Haywards Heath
West Sussex
RH16 3LB
England
Tel: +44(0)1 44444 1149
Fax: +44(0)1 44444 1192
E-mail: Office@ipapilot.com
Website: www.ipapilot.com

**END OF APPENDIX I – USEFUL ADDRESSES**

**APPENDIX J - GLOSSARY OF ABBREVIATIONS, TERMS AND DEFINITIONS**

**1. ABBREVIATIONS**

| | |
|---|---|
| AAC | Army Air Corps |
| AAT | Aircrew Aptitude Test |
| Ab Initio | Latin for “From the beginning”; as relating to Elementary Flying Training. |
| AC | Advisory Circular (USA FAA) |
| ACJ | Advisory Circulars ‘Joint’; EASA Information circulars |
| ACAS | Airborne Collision Avoidance System |
| AD | Airworthiness Directive (USA FAA). |
| ADF | Automatic Direction Finding; radio receiver with pointers displaying direction of a tuned radio beacon/station, over a compass repeater rose |
| AFIC | Arc Fault Interrupter Circuit |
| AIC | Aeronautical Information Circular (UK CAA) |
| ALPA | the Air Line Pilot Association (USA) |
| AMC | Acceptable Means of Compliance; EASA Information circulars |
| AME | Aviation Medical Examiner |
| APU | Auxiliary Power Unit; provides air and electricity when engines are shut down |
| ARB | Air Registration Board, UK Airworthiness Regulator before integration into CAA |
| ASAP | As Soon As Possible |
| ASR | Air Safety Report |
| ASRS | Aviation Safety Reporting System |
| ATC | Air Traffic Control |
| ATC | Air Training Corps (RAF) |
| ATCO | Air Traffic Control Officer |
| ATPL | Airline Transport Pilot Licence |
| AVM | Air Vice-Marshal (Senior RAF rank) |
| | |
| BAe | BAE Systems; (a UK Aerospace equipment manufacturer) |
| BAC | British Aircraft Corporation; predecessor of BAe |
| BALPA | British Air Line Pilots Association |
| BCF | Bromo-chloro-di-fluoromethane; Fire extinguishant gas (See Halon) |
| | |
| C | Captain; on checklists |
| CAA | Civil Aviation Authority, UK National Aviation Regulatory body |
| CAP | Civil Aviation Publication (UK CAA) |
| Capt. | Captain |
| CAR | Canadian Aviation Regulations |
| CCF | Combined Cadet Force |
| CEO | Chief Executive Officer; senior-most Company manager |
| CFIT | Controlled Flight Into Terrain |
| CFR | Crash Fire Rescue |
| C/L | Check List |
| CofG or | Centre of Gravity |
| C of G | Centre of Gravity |
| Co-Pi | Co Pilot/; First or Second officer |
| CPL | Commercial Pilot Licence |
| CRE | Class Rating Examiner |
| CRI | Class Rating Instructor |
| CRM | Crew Resources Management |
| CS | Certification Standard |
| CS-AWO | Certification Specifications for All Weather Operations; EASA document |
| CVR | Cockpit Voice Recorder |
| | |
| DDL | Deferred Defects List |
| DDM | Deferred Defects Manual |
| | |
| E | Engineer (Flight Engineer); on checklists |
| E&E | Electronics and Equipment (bay) |
| EASA | European Aviation Safety Agency |

| | |
|---|---|
| EASA CS | European Aviation Safety Agency Certification Standard |
| ECAM | Electronic Centralised Aircraft Monitoring |
| ECL | Electronic Check List |
| EFIS | Electronic Flight Information System |
| EICAS | Engine Indication and Crew Alerting System |
| ELT | Electronic Locator Beacon |
| EU | European Union |
| Eurocontrol | The European Organisation for the Safety of Air Navigation |
| EVAS | Emergency Vision Assurance System |
| EVS | Enhanced Vision System |
| | |
| FAA | Federal Aviation Administration, USA National Aviation Regulatory Body |
| FCL | Flight Crew Licensing |
| FE or F/E | Flight Engineer |
| FI | Flying Instructor |
| FMS | Flight Management System |
| FO or F/O | First Officer; (co-pilot) |
| FOG | Flight Operations Group; Royal Aeronautical Society, London |
| FPV | Fligh Path Vector |
| FRAeS | Fellow of the Royal Aeronautical Society |
| FSF | Flight Safety Foundation (USA based); pursues the continuous improvement of global aviation safety and the prevention of accidents. |
| ft. | feet or foot; measurement |
| FTO | Flying Training Organisation |
| | |
| GA | General Aviation |
| GAPAN | Guild of Air Pilots and Air Navigators |
| GASIL | General Aviation Safety Information Leaflet (UK CAA) |
| GCSE | General Certificate of Secondary Education |
| GCSE/S | General Certificate of Secondary Education / Scotland |
| GFDL | GNU Free Documentation Licence |
| GID | General Information Document (UK CAA) |
| GNU | GNU" is a recursive acronym that stands for "GNU's Not Unix"); the **GNU Project** is a free software, mass collaboration project (Wikipedia) |
| GPL | General Public Licence; the GPL was written by Richard Stallman in 1989 for use with programs released as part of the GNU project |
| GPWS | Ground Proximity Warning System |
| | |
| H | Helicopter(s) |
| Halon | BCF; Fire extinguishant gas (Bromo-chloro-di-fluoromethane) |
| Halon 1211 | BCF; Fire extinguishant gas (Bromo-chloro-di-fluoromethane) |
| Hotac | Hotel Accommodation |
| HUD | Head-Up Display |
| HUDLS | Head-Up Guidance Landing System |
| | |
| IATA | International Air Transport Association |
| ICAO | International Civil Aviation Organization |
| IEM | Interpretative & Explanatory Material; EASA Information circulars |
| IFE | In Flight Entertainment |
| IFR | Instrument Flight Rules |
| ILS | Instrument Landing System |
| INS | Inertial Navigation System |
| IOT | Initial Officers Training |
| IPA | Independent Pilots Association |
| I/R | Instrument Rating |
| IRE | Instrument Rating Examiner |
| | |
| JAA | Joint Aviation Authority |
| JAA CS | Joint Aviation Authority Certification Standard |
| JAR | Joint Aviation Regulations |
| JAR/FCL1 | JAA Flight Crew Licensing Requirements for Aeroplane Pilots |

| | |
|---|---|
| JAR/FCL2 | JAA Flight Crew Licensing Requirements for Helicopter Pilots |
| JAR/FCL3 | JAA Flight Crew Licensing Medical Requirements |
| | |
| kg. | Kilogramme; measure of weight |
| kt or kts | knot(s) |
| | |
| LASORS | Licensing, Administration & Standardisation, Operating Requirements & Safety; (UK CAA Publication) |
| Lbs | Pounds; avoirdupois measure of weight |
| Letromec | an Electro-Mechanical Company (USA) |
| LMC | Last Minute Change |
| LOC | Loss of Control |
| | |
| MCC | Multi Crew Co-operation |
| MD | McDonnell-Douglas; aircraft manufacturer, USA |
| MEL | Minimum Equipment List |
| Mike | Microphone |
| MITRE | USA-based Provider of Federally-funded Research & Development centres for the DOD, FAA (Centre for Advanced Aviation Systems Development) and the IRS. Also assists some overseas Government Agencies. |
| MLS | Microwave Landing System |
| MNPS | Minimum Performance Navigation System |
| MPA | Multi-Pilot Aeroplane |
| mSv | millisievert: SI unit of dose equivalent; a radiation measurement |
| | |
| n. | nautical; as in n. mile(s) |
| NAA | National Aviation (Regulatory) Authority |
| N1 | Navigator responsible for Navigation; before pilot navigation by INS and GPS |
| N1 | Engine component rotation speed measurement |
| N2 | Engine component rotation speed measurement |
| NASA | National Aeronautics and Space Administration |
| Nm | Nautical mile |
| NPRM | Notice of Proposed Rule Making |
| NPPL | National Private Pilot Licence; no longer available under EASA regulations |
| NTSB | (The) National Transportation Safety Board |
| | |
| P | Co-Pilot (on checklists); or could read F for F/O (First Officer) |
| P1 | Designator for the captain, (PIC) |
| P1(s) | Second pilot flying as P1 under supervision |
| P2 | Designator for the Co-pilot |
| PA | Public Address; for communications between captain and cabin passengers |
| PBE | Protective Breathing Equipment |
| PD | Public Domain |
| PIC | Pilot in Command |
| PF | Pilot Flying |
| PIO | Pilot Induced Oscillation |
| PLD | Personnel Licensing Department |
| PNF | Pilot Not Flying; but Monitoring |
| PM | Pilot Monitoring (this is Boeing terminology to emphasise that the role of PNF is an active *Monitoring* role) |
| PNF | Pilot Not Flying; monitoring |
| POW | Prisoner of War |
| PPL | Private Pilot Licence |
| | |
| QFI | Qualified Flying Instructor (Military) |
| QRH | Quick Reference Handbook |
| QRM | Quick Reference Manual |
| | |
| RAeS | Royal Aeronautical Society |
| RAF | Royal Air Force |
| RN | Royal Navy |
| RVSM | Reduced Vertical Separation Minima |

| | |
|---|---|
| SAFER | Special Aviation Fire and Explosion Reduction Advisory Committee (USA) |
| SEO | Senior Flight Engineer Officer |
| SEP | Safety Equipment and Procedures |
| SFE | Synthetic Flight Examiner |
| SFF | Smoke, Fire and Fumes |
| SFI | Synthetic Flight Instructor |
| S/O | Second Officer |
| SOP | Standard Operating Procedures |
| SPA | Single Pilot Aeroplanes |
| SSR | Secondary Surveillance Radar; used in conjunction with airborne Transponders for recognition by way of an assigned discrete Code Transmission ('Squawk') such as A2345 |
| STC | Supplemental Type Certificate |
| STEADES | Safety Trend Analysis, Evaluation and Data Exchange System |
| TO/GA | Take-off Go –around; aero-engine throttle setting |
| TRE | Type Rating Examiner |
| TRI | Type Rating Instructor |
| TRTO | Type Rating Training Organisation |
| TSO | Technical Standard Order |
| UAS | University Air Squadron |
| UK | United Kingdom |
| UKFSC | UK Flight Safety Committee. |
| URNU | University Royal Naval Unit |
| US or USA | United States of America |
| u/s | Unserviceable |
| USA | United States of America |
| V1 | Speed up to which take-off can be discontinued on a particular runway |
| $V_R$ | Rotation Speed; speed at which the aircraft is lifted off the ground and into the air during the take-off run |
| V2 | Minimum Safety speed after becoming airborne, for a given aircraft weight |
| VFR | Visual Flight Rules |
| Vat, or Vth & Vref | Velocity at threshold, for the selected landing configuration |
| WAAS | Wide Area Augmentation System |
| WBT | Web Based Training |

## 2. TERMS

**Flight Crew** In this entire document, the term Flight Crew is meant to describe the flight deck crewmembers. The terms cabin crew-member(s) or cabin staff is intended to mean passenger flight attendants.

**Load & Balance** The weight of the payload & passengers and their correct distribution on board, to ensure CofG limits are not infringed at all times

## 3. DEFINITIONS (*See also Appendix E – AOM, for the full underpinning ICAO definition*)

1. **DA = Decision Altitude.** The Decision Altitude on the **barometric altimeter set to QNH** is the point at which a Go-around ***must*** be initiated if the required visual reference to continue the approach has not been established on a precision approach.

2. **DH = Decision Height.** Decision Height is The **Radio Altimeter** height (or **QFE** height), above the runway threshold at which a Go Around ***must*** be initiated if the required visual reference to continue the approach has not been established on a precision approach.

3. **FAF = Final Approach Fix.** The Final Approach Fix must be crossed at +100 feet/-0 ft. It is denoted by a beacon or a DME distance.

4. **Load & Balance =** Aircraft total weight (Mass) and CofG position statement; prepared before take-off, for the attention of the operating crew, to allow the correct setting on the ASI of the various vital airspeed V-speeds for departure and the necessary take-off elevator trim position.

5. **MAPt = Missed Approach Point.** The missed approach point is where or before which a Go-around ***must*** be initiated.

6. **MDA = Minimum Descent Altitude.** Descent must not be made without the required visual reference on a non-precision approach and for manoeuvring on circling approaches below this altitude. It is referenced on the airport reference point elevation.

7. **PLATFORM ALTITUDE** is the altitude where the aircraft flies level prior to intercepting the Glide Path.

8. **STABLE APPROACH =** Aircraft configuration on the final descent profile:
   a. To be in the landing configuration, gear down and landing flap set.
   b. On the glide slope or correct vertical profile.
   c. Approach power set and stable.
   d. Indicated air speed no more than Vref + 20 Kts.

**Load & Balance … a term with wide implications.**


**OOOPS !**



**END OF APPENDIX J – ABBREVIATIONS & TERMS**

**APPENDIX K - INDEX OF EU-OPS 1 CONTENTS**

**COMMERCIAL AIR TRANSPORTATION (AEROPLANES)**

**FOREWORD**

This Appendix lists the contents of the new EU-OPS-1 Regulatory document that replaces JAA/JAR-OPS 1 that is no longer in force. EU-OPS will be followed by EASA-OPS. The list also refers to *Advisory Circulars 'Joint'* **(ACJ),** *Acceptable Means of Compliance* (AMC) and *Interpretative & Explanatory Material* **(IEM)** which refer. Where the European Aviation Safety Agency (EASA) has not yet published the relevant material, reference to JAR-OPS will continue until such time as the transition to all-EASA documentation is completed.

From April 2012 a new set of regulations come into force being 'EASA-OPS'. In most areas there will be little or no change from EU OPS but EASA OPS applies to all professional flying including Business Jet Operations and the operations of Professional Aviation Training Organisations. For example FTL schemes are required for this category of operators. The same thing applies to FCL matters.

EU-OPS 1 applies to all flight operations in the European Community (EC) by the Member States that have signed the '*Arrangements Concerning the Development and the Acceptance of Joint Aviation Requirements'*. The EC Countries are Albania, Armenia, Austria, [Azerbaijan], Belgium, Bosnia, & Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, European Aviation Safety Agency, Finland, the Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Monaco, Netherlands, Norway, Poland, Portugal, Republic of Moldova, [Republic of Georgia], Romania, Serbia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine & United Kingdom. States shown in brackets thus [ xxxx ] are in the process of joining the Community. Iceland, Norway and Switzerland though not part of the EC, have voluntarily agreed to adopt the EASA regulatory umbrella, having signed a governmental agreement to enact all EASA legislation in their own countries.


**EC Member States**

At the time of going to press European Flight Operations are governed by EU-OPS but the European Community has decided that from April 2012 both Flight Operations and Flight Crew Licensing regulation will become the responsibility of the European Aviation Safety Agency (EASA). EASA has already produced draft requirements which are currently under consultation with industry and other stakeholders and expects to promulgate these during 2010. EASA Regulations are based largely on EU-OPS and JAR-FCL.

**EASA EU-OPS - 1 CONTENTS INDEX**



**EU-OPS 1 CONTENTS**

**COMMERCIAL AIR TRANSPORTATION (AEROPLANES)**

**SUBPART A — APPLICABILITY**

**SECTION 1 - REQUIREMENTS**

**SUBPART B — GENERAL**



**SUBPART C — OPERATOR CERTIFICATION AND SUPERVISION**



**SUBPART D — OPERATIONAL PROCEDURES**

**SUBPART I — PERFORMANCE CLASS C**



**SUBPART J — MASS AND BALANCE**



**SUBPART K — INSTRUMENTS AND EQUIPMENT**

**SUBPART L — COMMUNICATION AND NAVIGATION EQUIPMENT**



**SUBPART M — AEROPLANE MAINTENANCE**



**SUBPART N — FLIGHT CREW**

**SUBPART O — CABIN CREW**



**SUBPART P — MANUALS, LOGS AND RECORDS**



**SUBPART Q — FLIGHT AND DUTY TIME LIMITATIONS AND REST REQUIREMENTS**

RESERVED

**SUBPART R — TRANSPORT OF DANGEROUS GOODS BY AIR**

| | |
|---|---|
| EU–OPS 1.1155 | Approval to Transport Dangerous Goods |
| EU–OPS 1.1160 | Scope |
| EU–OPS 1.1165 | Limitations on the Transport of Dangerous Goods |
| EU–OPS 1.1190 | Intentionally blank |
| EU-OPS 1.1195 | Acceptance of Dangerous Goods |
| EU–OPS 1.1200 | Inspection for Damage, Leakage or Contamination |
| EU–OPS 1.1205 | Removal of Contamination |
| EU–OPS 1.1210 | Loading Restrictions |
| EU–OPS 1.1215 | Provision of Information |
| EU–OPS 1.1220 | Training programmes |
| EU–OPS 1.1225 | Dangerous Goods Incident and Accident Reports |
| Appendix 1 to EU-OPS 1.1225 | Dangerous Goods Incident and Accident Reports |
| EU–OPS 1.1230 | Intentionally blank |

**SUBPART S — SECURITY**

| | |
|---|---|
| EU–OPS 1.1235 | Security requirements |
| EU–OPS 1.1240 | Training programmes |
| EU–OPS 1.1245 | Reporting acts of unlawful interference |
| EU–OPS 1.1250 | Aeroplane search procedure checklist |
| EU–OPS 1.1255 | Flight crew compartment security |

**SECTION 2 - ADVISORY CIRCULARS JOINT (ACJ)/ACCEPTABLE MEANS OF COMPLIANCE (AMC) & INTERPRETATIVE/EXPLANATORY MATERIAL (IEM)**

GENERAL AND PRESENTATION

**ACJ/AMC/IEM B – GENERAL**

| | |
|---|---|
| ACJ to Appendix 1 to EU-OPS 1.005(a) | Operations of performance class B aeroplanes |
| AMC OPS 1.035 | Quality System |
| IEM OPS 1.035 | Quality System – Organisation examples |
| IEM OPS 1.037 | Accident prevention and flight safety programme |
| AMC OPS 1.037(a)(2) | Occurrence Reporting Scheme |
| ACJ OPS 1.037(a)(4) | Flight Data Monitoring Programme |
| IEM OPS 1.065 | Carriage of weapons of war and munitions of war |
| IEM OPS 1.070 | Carriage of sporting weapons |
| ACJ OPS 1.085(e)(3) | Crew responsibilities |
| ACJ OPS 1.160(a)(1) and (2) | Preservation of Recordings |
| ACJ OPS 1.165(b)(2) | Leasing of aeroplanes between JAA operators |
| ACJ OPS 1.165(c)(2 | Leasing of aeroplanes between a JAA operator and any entity other than an EASA operator |

**ACJ/AMC/IEM C — OPERATOR CERTIFICATION & SUPERVISION**

| | |
|---|---|
| IEM OPS 1.175 | he management organisation of an AOC holder |
| IEM OPS 1.175(c)(2) | Principal place of business |
| ACJ OPS 1.175(i) | Nominated Post-holders – Competence |
| ACJ OPS 1.175(j) | Combination of nominated post-holders' responsibilities |
| ACJ OPS 1.175(j) & (k) | Employment of staff |
| IEM OPS 1.185(b) | Maintenance Management Exposition details |

**ACJ/AMC/IEM D — OPERATIONAL PROCEDURES**

| | |
|---|---|
| ACJ OPS 1.195 | Operational Control |
| ACJ OPS 1.205 | Competence of Operations personnel |
| AMC OPS 1.210(a) | Establishment of procedures |
| IEM OPS 1.210(b) | Establishment of procedures |
| ACJ OPS 1.216 | In-flight Operational Instructions |

| | |
|---|---|
| ACJ OPS 1.243 | Operations in areas with specified navigation performance requirements |
| IEM OPS 1.245(a) | Maximum distance from an adequate aerodrome for two-engined aeroplanes without ETOPS Approval |
| AMC OPS 1.245(a)(2) | Operation of non-ETOPS compliant twin turbojet aeroplanes between 120 and 180 minutes from an adequate aerodrome |
| IEM OPS 1.250 | Establishment of Minimum Flight Altitudes |
| [ACJ OPS 1.255 | Contingency Fuel Statistical Method |
| IEM OPS 1.260 | Carriage of persons with Reduced Mobility |
| AMC OPS 1.270 | Cargo carriage in the passenger cabin |
| ACJ OPS 1.280 | Passenger Seating |
| IEM OPS 1.280 | Passenger Seating |
| ACJ OPS 1.297(b)(2) | Planning Minima for Alternate Aerodromes |
| AMC OPS 1.297 | Application of aerodrome forecasts |
| AMC OPS 1.300 | Submission of ATS Flight plan |
| IEM OPS 1.305 | Re/Defuelling with passengers embarking, on board or disembarking |
| IEM OPS 1.307 | Refuelling/Defuelling with wide-cut fuel |
| ACJ OPS 1.308 | Push Back and Towing |
| ACJ OPS 1.310(a)(3) | Controlled rest on flight deck |
| IEM OPS 1.310(b) | Cabin crew seating positions |
| ACJ OPS 1.345 | Ice and other contaminants |
| ACJ OPS 1.346 | Flight in expected or actual icing conditions |
| ACJ OPS 1.390(a)(1) | Assessment of Cosmic Radiation |
| ACJ OPS 1.390(a)(2) | Working Schedules and Record Keeping |
| ACJ OPS 1.390(a)(3) | Explanatory Information |
| ACJ OPS 1.398 | Use of Airborne Avoidance System (ACAS) |
| IEM OPS 1.400 | Approach and Landing Conditions |
| Appendix 1 to AMC OPS 1.245(a)(2) | Power supply to essential services |

**ACJ/AMC/IEM E — ALL WEATHER OPERATIONS**

| | |
|---|---|
| AMC OPS 1.430(b)(4) | Effect on Landing Minima of temporarily failed or downgraded Ground Equipment |
| IEM OPS 1.430 | Documents containing information related to All Weather Operations |
| IEM to Appendix 1 to EU-OPS 1.430 | Aerodrome Operating Minima |
| IEM to Appendix 1to EU-OPS 1.430, paragraphs (d) and (e) | Establishment of minimum RVR for Category II and III Operations |
| IEM to Appendix 1 to EU-OPS 1.430, paragraph (2)(5) Table 7 | Crew actions in case of autopilot failure at or below decision height in fail Passive Category III operations |
| IEM to Appendix 1 to EU-OPS 1.430, paragraph (f) | Visual Manoeuvring (circling) |
| ACJ to Appendix 1 EU-OPS 1.440 | Operational Demonstrations |
| IEM to Appendix 1 to EU-OPS 1.440, Paragraph (b) | Criteria for a successful CAT II/III approach and automatic landing |
| IEM OPS 1.450(g)(1) | Low Visibility Operations - Training & Qualifications |

**ACJ/AMC/IEM F - PERFORMANCE GENERAL**

| | |
|---|---|
| AMC OPS 1.475(b) | Landing - Reverse Thrust Credit |
| IEM OPS 1.475(b) (Performance Class ‘A’ Aeroplanes only) | Factoring of Automatic Landing Distance Performance Data |

**ACJ/AMC/IEM G — PERFORMANCE CLASS A**

| | |
|---|---|
| IEM OPS 1.485(b) | General – Wet and Contaminated Runway data |
| IEM OPS 1.490(c)(3) | Take-off – Runway surface condition |
| IEM OPS 1.490(c)(6) | Loss of runway length due to alignment |
| IEM OPS 1.495(a) | Take-off obstacle clearance |

| | |
|---|---|
| AMC OPS 1.495(c)(4) | Take-off obstacle clearance |
| AMC OPS 1.495 (d)(1) & (e)(1) | Required Navigational Accuracy |
| IEM OPS 1.495(f) | Engine failure procedures |
| AMC OPS 1.500 | En-Route – One Engine Inoperative |
| IEM OPS 1.510(b) and (c) | Landing – Destination and Alternate Aerodromes |
| AMC OPS 1.510 & 1.515 | Landing – Destination and Alternate Aerodromes Landing – Dry Runways |
| IEM OPS 1.515(c) | Landing – Dry runway |

**ACJ/AMC/IEM H — PERFORMANCE CLASS B**

| | |
|---|---|
| AMC OPS 1.530(c)(4) | Take-Off Performance Correction Factors |
| IEM OPS 1.530(c)(4) | Take-Off Performance Correction Factors |
| AMC OPS 1.530(c)(5) | Runway Slope |
| IEM OPS 1.535 | Obstacle Clearance in Limited Visibility |
| AMC OPS 1.535(a) | Take-off Flight Path Construction |
| IEM OPS 1.535(a) | Take-off flight path construction |
| IEM OPS 1.540 | En-Route |
| IEM OPS 1.542 | En-route – Single-engine Aeroplanes |
| AMC OPS 1.542(a) | En-Route - Single-engine Aeroplanes |
| AMC OPS 1.545 & 1.550 | Landing Destination and Alternate Aerodromes Landing - Dry runway |
| AMC OPS 1.550(b)(3) | Landing Distance Correction Factors |
| AMC OPS 1.550(b)(4) | Runway Slope |
| IEM OPS 1.550(c) | Landing – Dry Runway |
| IEM OPS 1.555(a) | Landing on Wet Grass Runways |

**ACJ/AMC/IEM I — PERFORMANCE CLASS C**

| | |
|---|---|
| IEM OPS 1.565(d)(3) | Take-off |
| IEM OPS 1.565(d)(6) | Loss of runway length due to alignment |
| AMC OPS 1.565(d)(4) | Runway Slope |
| AMC OPS 1.570(d) | Take-off Flight Path |
| AMC OPS 1.570(e)(1) & (f)(1) | Required Navigational Accuracy |
| AMC OPS 1.580 | En-Route – One Engine Inoperative |
| AMC OPS 1.590 & 1.595 | Landing – Destination and Alternate Aerodromes Landing – Dry Runways |
| AMC OPS 1.595(b)(3) | Landing Distance Correction Factors |
| AMC OPS 1.595(b)(4) | Runway Slope |
| IEM OPS 1.595(c) | Landing Runway |

**ACJ/AMC/IEM J — MASS & BALANCE**

| | |
|---|---|
| IEM OPS 1.605(e) | Fuel density |
| ACJ OPS 1.605 | Mass values |
| AMC to Appendix 1 to EU-OPS 1.605 | Accuracy of weighing equipment |
| IEM to Appendix 1 to EU-OPS 1.605 | Centre of gravity limits |
| AMC OPS 1.620(a) | Passenger mass established by use of a verbal statement |
| IEM OPS 1.620(d)(2) | Holiday Charter |
| IEM OPS 1.620(g) | Statistical evaluation of passenger and baggage mass data |
| IEM OPS 1.620(h) & (i) | Adjustment of standard masses |
| AMC to Appendix 1 to EU-OPS 1.620(g) | Guidance on passenger weighing surveys |
| IEM to Appendix 1 to EU-OPS 1.620(g) | Guidance on passenger weighing surveys |
| IEM to Appendix 1 to EU-OPS 1.625 | Mass and balance documentation |

**ACJ/AMC/IEM K — INSTRUMENTS AND EQUIPMENT**

| | |
|---|---|
| IEM OPS 1.630 | Instruments and Equipment - Approval and Installation |
| AMC OPS 1.650/1.652 | Flight and Navigational Instruments and Associated Equipment |
| IEM OPS 1.650/1.652 | Flight and Navigational Instruments and Associated Equipment |

**ACJ/AMC/IEM O — CABIN CREW**



**ACJ/AMC/IEM P — MANUALS, LOGS & RECORDS**



**ACJ/AMC/IEM Q — FLIGHT AND DUTY TIME LIMITATIONS AND REST REQUIREMENTS**

RESERVED

**ACJ/AMC/IEM R — TRANSPORT OF DANGEROUS GOODS BY AIR**

| | |
|---|---|
| ACJ OPS (IEM) 1.1160 (c)(1) | Scope – Dangerous goods carried by passengers or crew |
| ACJ OPS (IEM) 1.1165(b) | Exemption and approval procedures of the technical instructions |
| ACJ OPS 1.1215(c)(1) | Information to the commander |
| ACJ OPS (AMC) 1.1215(e) | Information in the Event of an in-flight emergency |
| ACJ OPS (AMC) 1.1220 | Training |
| ACJ OPS (AMC) 1.1225 | Dangerous Goods Incident and Accident Reports |

**ACJ S — SECURITY**

| | |
|---|---|
| ACJ OPS 1.1240 | Training Programmes |

… Cruising. **Pictures © Captain Philip 'Phil' H S SMITH MRAeS (BA ret)**

… with particular thanks to Phil Smith (pictured above) for his wise counsel.

**END OF APPENDIX K - INDEX OF EU-OPS 1 CONTENTS**

***END OF SO YOU WANT TO BE A CAPTAIN?***

**LEAD BY EXAMPLE**

**ENCOURAGE YOUR CREW TO WORK TOGETHER AS A FRIENDLY TEAM**

**LISTEN …**

**FLY HAPPY, FLY FUN … BUT MOST OF ALL FLY SAFE … and … ENJOY IT.**