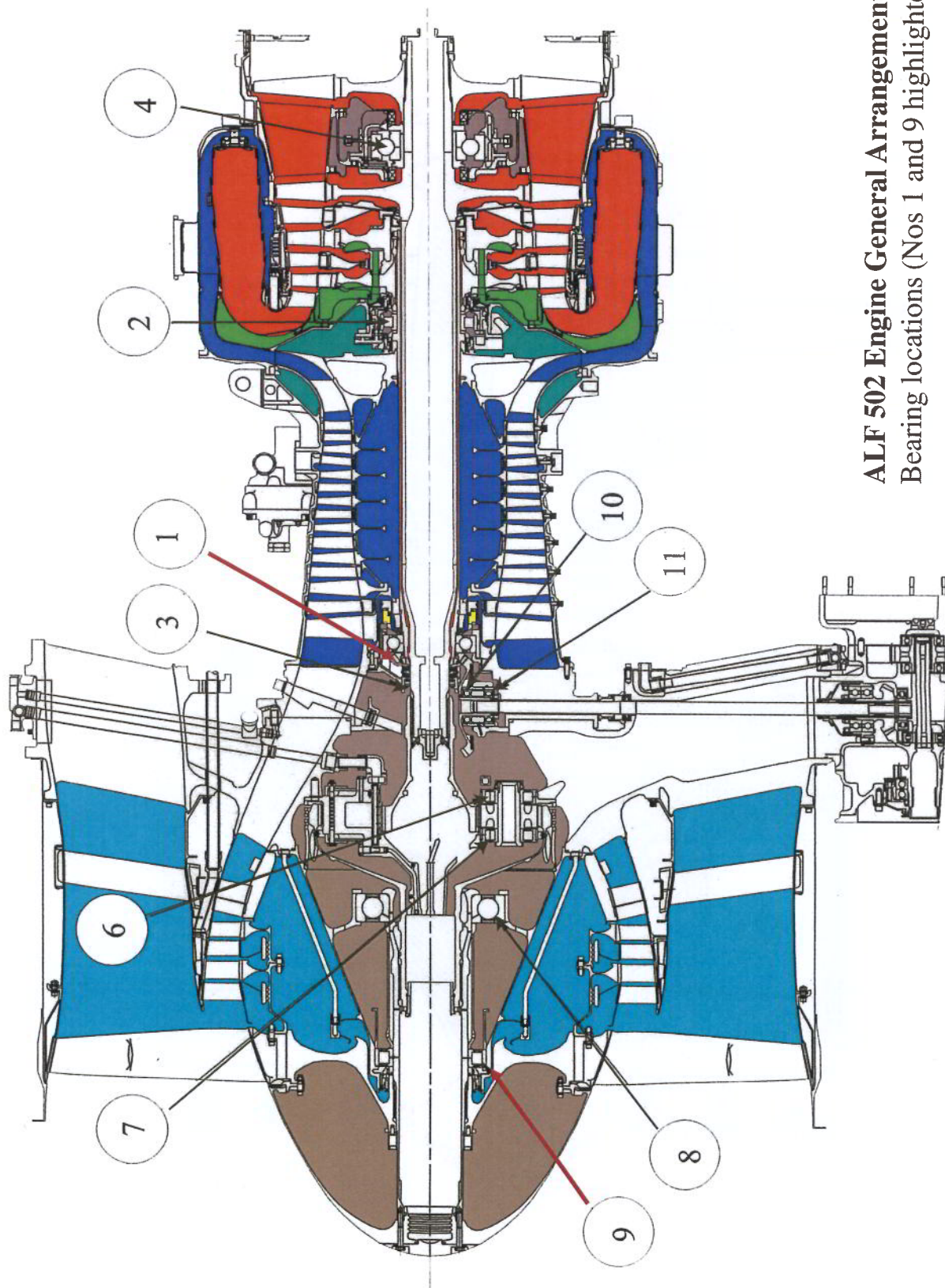
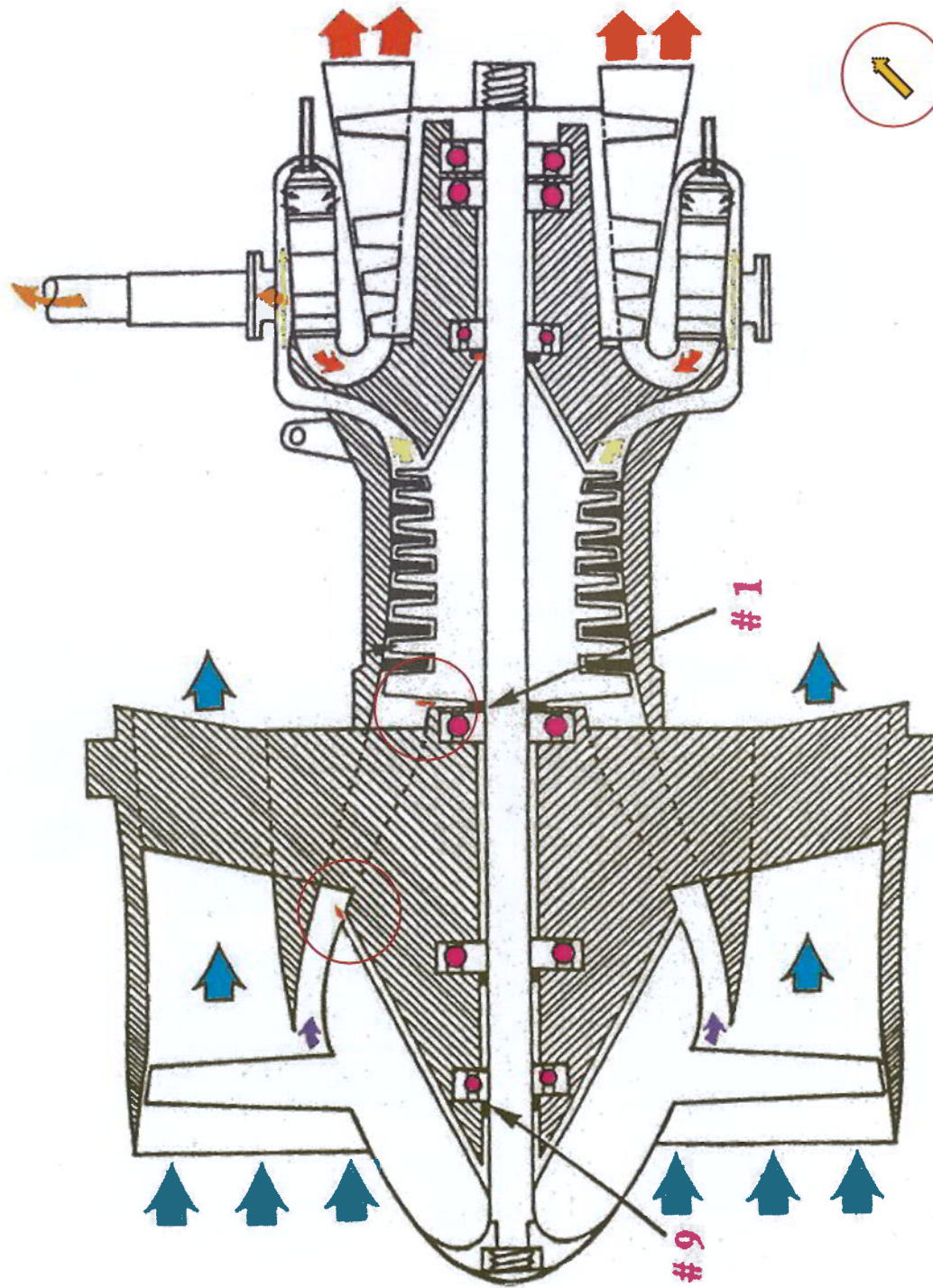


Figure 1



ALF 502 Engine General Arrangement  
Bearing locations (Nos 1 and 9 highlighted)

Figure 2



Potential oil leakage paths from bearing Nos 1 and 9 seals in to main gas stream

**Simplified image of the ALF 502 engine**  
 Courtesy BAe Systems

Figure 3

## APU Details

Cooling fan \*

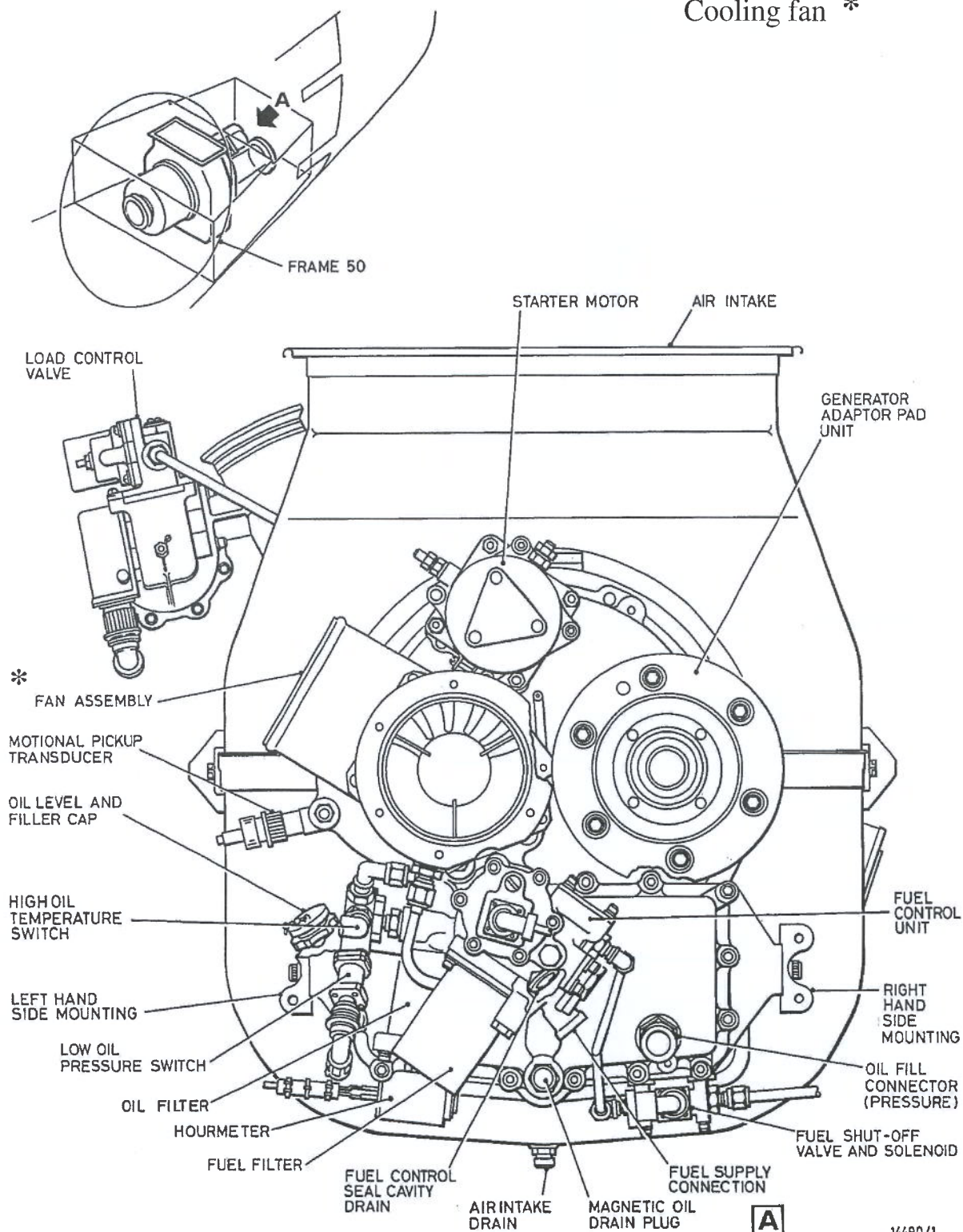
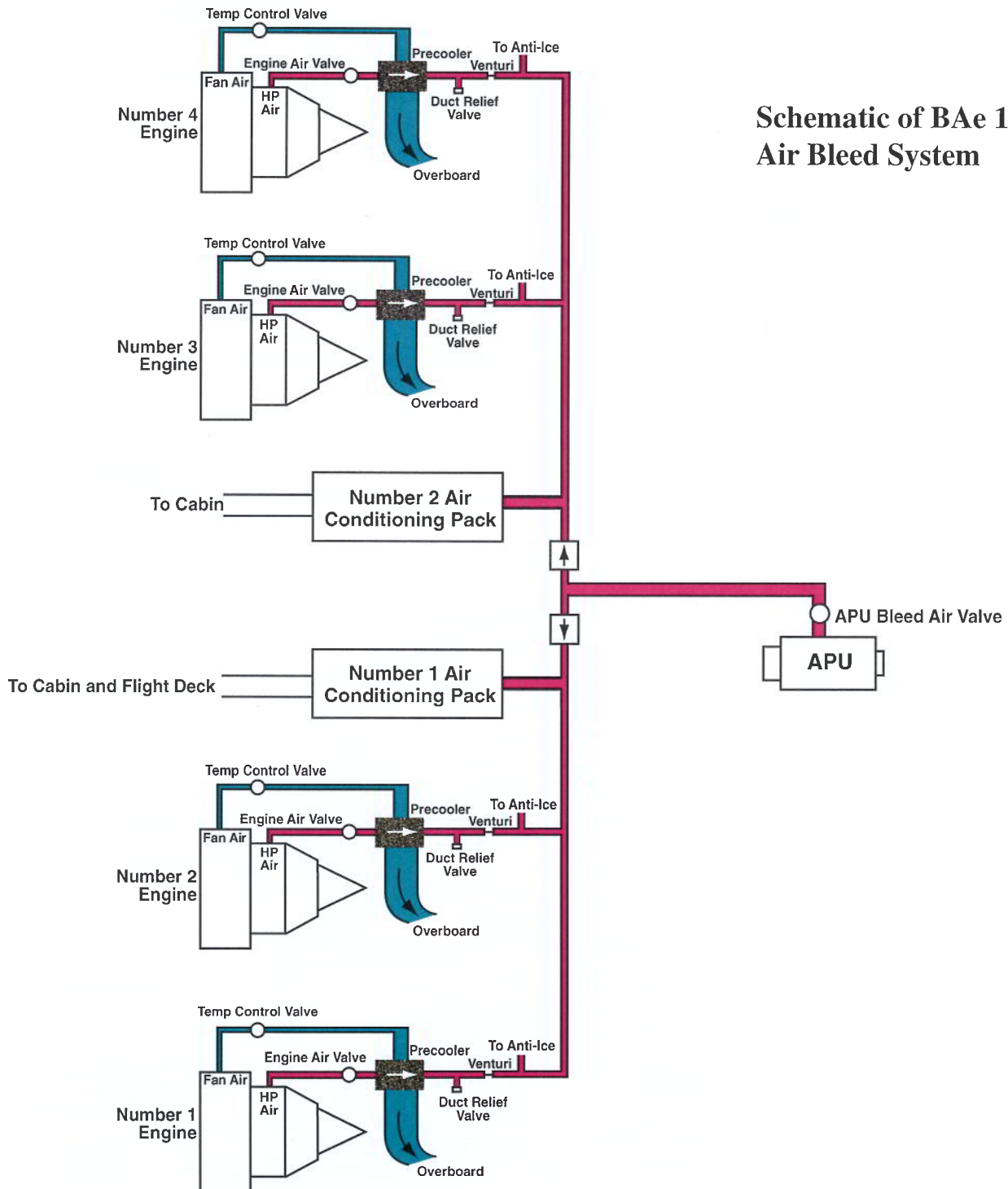
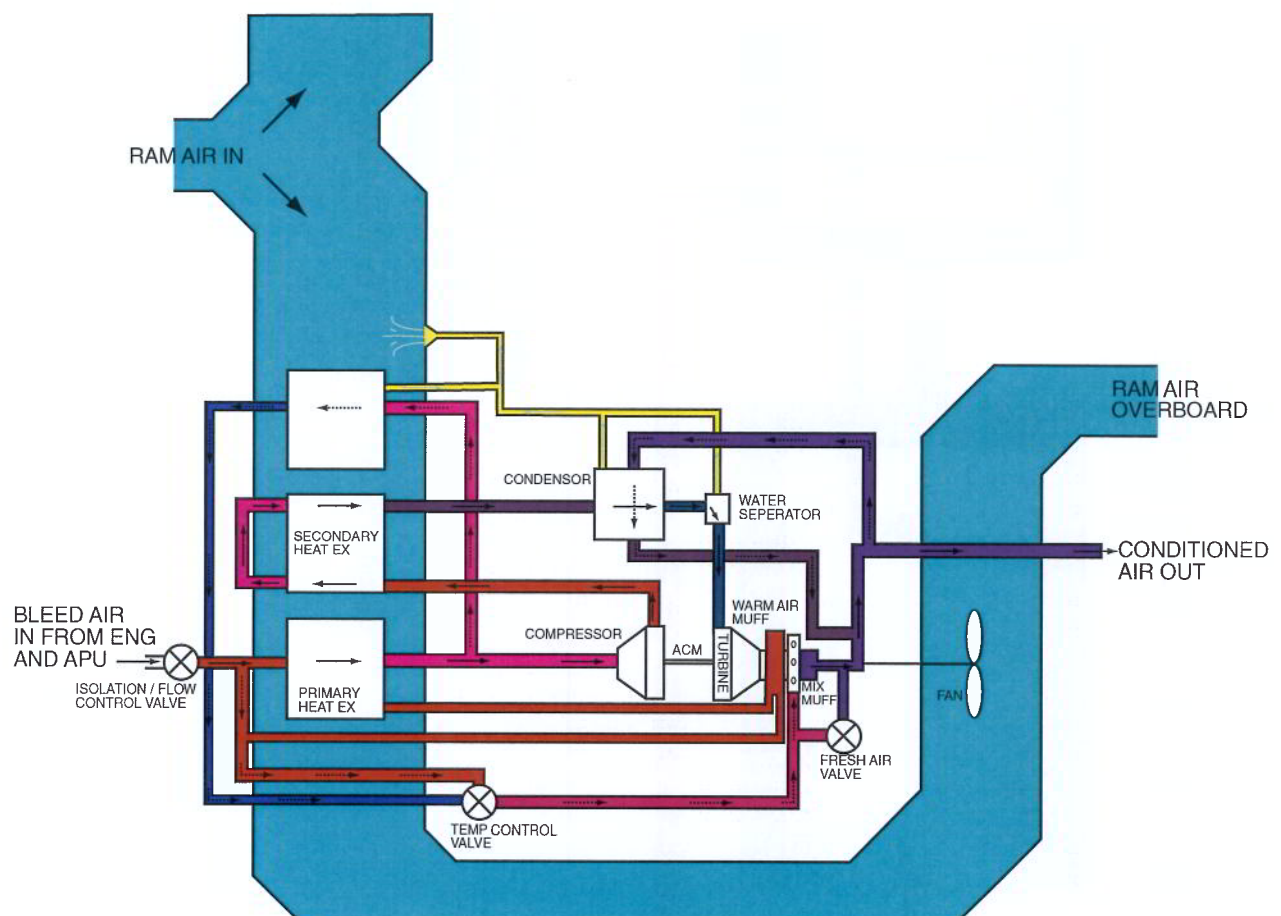


Figure 4

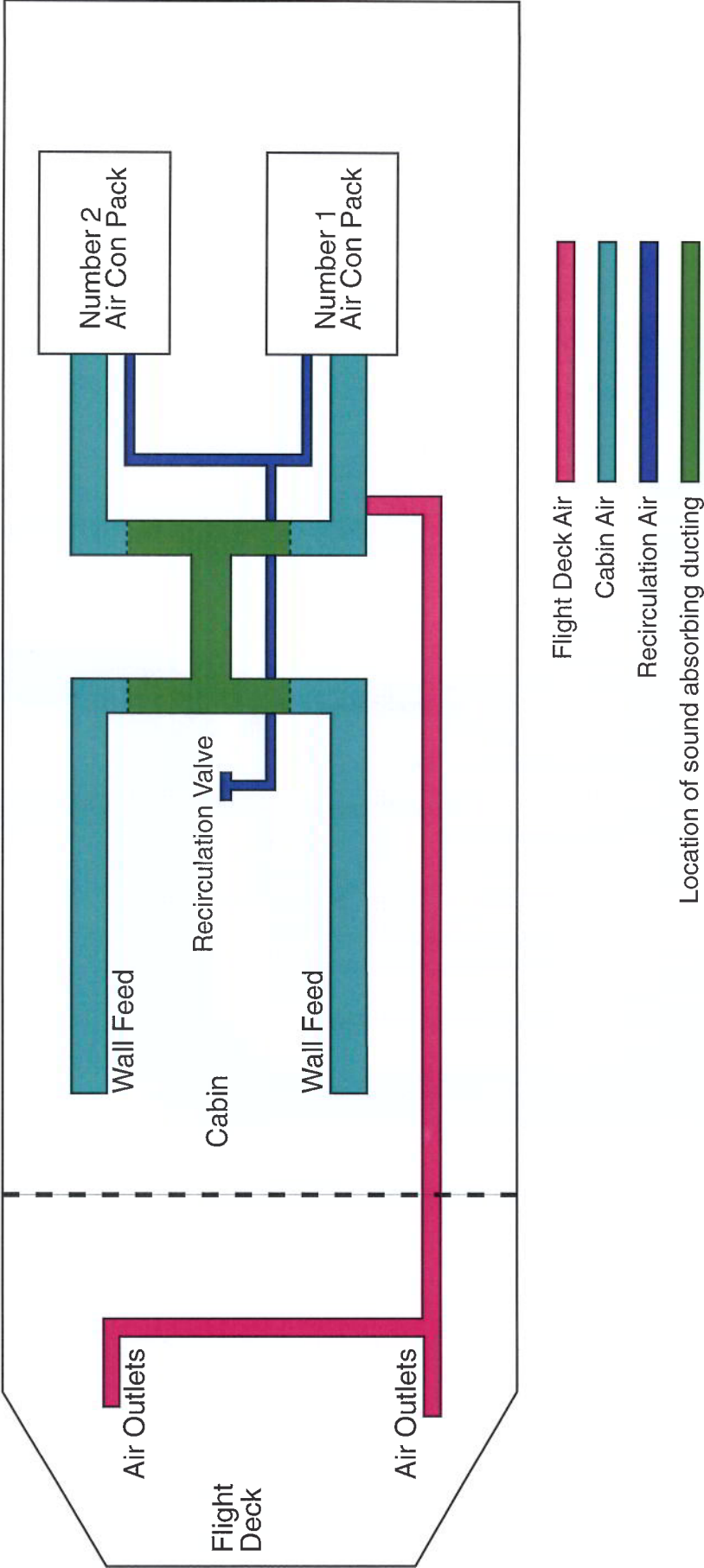


**Figure 5**



**Schematic of BAe 146 ECS Pack**

Figure 6



Schematic of BAe 146 Air Distribution System

Correct as of 14/11/03

## Level 1 Flight Deck Occurrences by Year and Severity (All Types- From UK MORs)

Level of Severity (see table 3)	1996	1997	1998	1999	2000	2001	2002	2003
Incapacitation					BAE 146			
Partial Incapacitation		BAE 146		BAE146				
Impairment		BAE 146		BAE146 B757	BAE146 B757	B757		
Slight Impairment				BAE146 B757 <b>B737</b>	BAE146 BAE146 B757 <b>F100</b>	BAE146 BAE146 B757 B757 B757 <b>B737 DHC8</b>	BAE146 BAE146 BAE146 BAE146 B757 B757	
Feeling Unwell	<b>DHC 8</b> <b>F100</b> <b>B747</b>	BAE14 6 B757 <b>A320</b>		BAE146 B757	BAE146 B757	BAE146 BAE146 BAE146 B757 R757 R757	BAE146 BAE146 BAE146 R757	B757 <b>EMB145</b>
Irritation		B757				BAE146 B757 B757 B757 B757 B757	BAE146	B757 B757 <b>A321</b>

Slide 1

Figure 7



# Aviation Safety


[Search](#)
[Aviation](#)
[Marine](#)
[Rail](#)
[Road](#)
[Home](#)

## SAFETY ACTION & RECOMMENDATIONS - DETAIL

| [Safety Action Taken](#) | [Recommendations](#) | [Safety Advisory Notices](#) |

### Recommendation

Central to ATSB's investigation of aviation accidents and incidents is the early identification of safety deficiencies in the civil aviation environment. The Bureau issues recommendations to regulatory authorities, operators, manufacturers or other agencies in order to address safety deficiencies. Recommendations may be issued in conjunction with ATSB reports or independently. A safety deficiency may lead to a number of similar recommendations, each issued to a different agency. [\[More...\]](#).

**\*Output No.:** R19990052

**\*Date Issued:** 06-Sep-99

**\*Background:** [Why this recommendation was developed...](#)

**\*Output Text:** The Bureau of Air Safety Investigation recommends that the Civil Aviation Safety Authority, in conjunction with the aircraft manufacturer, British Aerospace Plc, address deficiencies that permit the entry of fumes into the cockpit and cabin areas of BAe146 aircraft. These deficiencies should be examined by the regulatory authority as part of its' responsibilities for initial certification and continued airworthiness of the BAe 146 Aircraft.

As a result of the investigation into this occurrence, the Bureau simultaneously issues recommendation R990053 to British Aerospace Plc:

"The Bureau of Air Safety Investigation recommends that British Aerospace Plc liaise with the engine manufacturer, AlliedSignal, to investigate failures within the engine that result in fumes entering the cockpit and cabin areas of BAe146 aircraft".

	Organisation	Response Received	Date Received	Response Status
<b>*Response From:</b>	Civil Aviation Safety Authority	Yes	21-Jan-00	Monitor
<b>*Response Text:</b>	In the lengthy period between the incident and the release of your report, CASA has investigated this issue in considerable detail, in conjunction with the aircraft manufacturer and the major Australian operators. As a result of this work, and discussions with the certifying authority (the UK Civil Aviation Authority), CASA is satisfied that the BAe146 aircraft in service in Australia are safe for public transport. CASA technical specialists are available to brief your investigators on the scope and findings of this work.			

As your recommendation does not specify the nature of any additional deficiencies that the Bureau believes need to be addressed by CASA and the aircraft manufacturers, I am seeking details of any deficiencies that you believe have not been appropriately dealt with. It would also assist us in providing a meaningful and constructive response to your recommendations if you were to provide us with details of any incidents that have occurred since the original incident in 1997.

In the meantime, we will continue to monitor the situation and review any information that comes to hand.

**\*ATSB Response:** The following letter was sent to the Civil Aviation Safety Authority on 24 January 2000:

Thank you for your response to Occurrence Brief 199702276 and Recommendation R19990052 dated 5 November 1999.

## Appendix 1

In regard to the detailed investigation CASA has carried out in conjunction with the manufacturer and UK CAA, your conclusion that the BAe 146 aircraft type is safe for public transport in Australia has been noted.

This has been a very complex issue and to ensure that the ATSB is fully conversant with the reasons behind your conclusions, I would be most pleased to accept your offer of a CASA technical specialist briefing of our investigators. To facilitate planning, your early advice as to when this could take place is sought.

**Back one step**

\*Page updated: 08-Sep-2003

[\[Help\]](#) [\[Search\]](#) [\[Subscribe\]](#) [\[Newsroom\]](#) [\[Copyright\]](#) [\[Privacy\]](#) [\[Webmaster\]](#)



# Aviation Safety



Search

[Aviation](#)[Marine](#)[Rail](#)[Road](#)[Home](#)

## SAFETY ACTION & RECOMMENDATIONS - DETAIL

[Safety Action Taken](#) | [Recommendations](#) | [Safety Advisory Notices](#)

### Recommendation

Central to ATSB's investigation of aviation accidents and incidents is the early identification of safety deficiencies in the civil aviation environment. The Bureau issues recommendations to regulatory authorities, operators, manufacturers or other agencies in order to address safety deficiencies. Recommendations may be issued in conjunction with ATSB reports or independently. A safety deficiency may lead to a number of similar recommendations, each issued to a different agency. [\[More...\]](#)

**Output No:** R19990053

**Date Issued:** 06-Sep-99

**Background:** [Why this recommendation was developed...](#)

**Output Text:** The Bureau of Air Safety Investigation recommends that British Aerospace Plc liaise with the engine manufacturer, AlliedSignal, to investigate failures within the engine that result in fumes entering the cockpit and cabin areas of BAe146 aircraft.

As a result of the investigation of this occurrence, the Bureau simultaneously issues recommendation R990052 to the Civil Aviation Safety Authority:

"The Bureau of Air Safety Investigation recommends that the Civil Aviation Safety Authority, in conjunction with the aircraft manufacturer, British Aerospace Plc, address deficiencies that permit the entry of fumes into the cockpit and cabin areas of BAe146 aircraft. These deficiencies should be examined by the regulatory authority as part of its' responsibilities for initial certification and continued airworthiness of the BAe 146 Aircraft".

	Organisation	Response Received	Date Received	Response Status
<b>Response From:</b>	British Aerospace Plc	Yes	14-Mar-00	Closed-Partially Accepted
<b>Response Text:</b>	<p>I am in receipt of the second draft of the above report, made available to me on 24 August. Whilst we are grateful for the opportunity to make verbal comments to you, we are dismayed at the time made available to us to do so, (i.e. by 9am Thursday August 25), especially given the time differences existing between me and my colleagues in the United Kingdom. Given the importance of the matter, I have set out below the substance of those comments, which in the time available, we have formulated:</p> <p>1. Bae's Previous comments</p> <p>1.1 As you are aware, BAe submitted a detailed response to the first draft of the report on 22 July 1999. Despite various requests, we were not afforded the opportunity to discuss our submission or the Report with you or any members of your team in person. Given the nature of the Report and its recommendations, we were surprised at this lack of consultation.</p> <p>1.2 Similarly, we are also disappointed to note that the second draft fails to take into account or address the majority of our comments. In particular, it fails to answer the majority of the points we raised in paragraphs 1, relating to flight crew procedure, and 2, maintenance procedures, and why those procedures were not followed.</p> <p>1.3 According to the Report, the cause of the incident was oil contamination of the air supply, (although there is no evidence of the investigative basis for this finding). BAe accepts that from time to time oil may leak into the air</p>			

system. However, as we have previously advised, when it became evident that this was occurring, BAe in conjunction with Allied Signal in between 1991 and 1992, developed modifications to reduce the frequency of such leaks. A customer option of an oil filtration system was also introduced. No mention is made of such modifications in your Report, or even whether the aircraft in question was fitted with them. Given such modifications, we consider that the safety recommendations in your Report have already been complied with.

1.4 In any event, on the basis of the circumstances described in the Report, the sole reason why this incident occurred is because maintenance and operating procedures set out in the relevant MEL were not followed. Had the defective air supply been correctly labelled and isolated, the alleged oil contamination would not have occurred (as is demonstrated by the fact that when the flight continued the scheduled sectors with the number 4-engine bleed air system turned off, these were completed without incident). Further, the aircraft appears to have been operated for more than the ten-day period set out (recommended) in the MEL. Given these facts, we are surprised that these matters are not referred to in the Report.

1.5 Similarly, basic aircrewmanship dictates that in this type of situation oxygen masks should have been immediately donned. If this had been the case, the affected crewmembers would not have been prevented from properly carrying out their assigned duties, and hence there should have been no threat to air safety. We do not consider the comment "the crew did not consider the use of oxygen masks necessary in the situation", to be an adequate explanation of why this was not done.

## 2. Anecdotal Evidence

2.1 Much of the report relates to purely anecdotal evidence of other incidents. You seek to link these with the incident under investigation. While the nature of the Report makes it impossible for us to comment on or assess the further incidents referred to, it is our firm view that recent complaints regarding cabin air quality arise from circumstances largely unconnected to oil contamination and are not therefore relevant to the incident under investigation. Yet, not only does the Report refer extensively to this anecdotal evidence, it fails to mention the additional customer optional modifications that BAe has recently developed in conjunction with Ansett Australia to address cabin air quality issues and which are currently being embodied on Ansett's fleet.

## 3. Failure to ICAO Practices

We have expressed our disappointment at your refusal to have a meeting with us to discuss this Report. We also understand that you failed to follow ICAO guidelines as set out in Annex 13, in that you failed to follow standard reporting layout and that you made no format notification to the UK Air Investigation Board. We understand that the AA1B have made separate representations to you to that effect. We also are led to believe that, at no stage, did you contact UK Civil Aviation Authority, the Design Authority for the aircraft.

## 4. Conclusion

In summary, our position remains that we continue to disagree with the substance of your Report. We again request the opportunity to meet with you and your team to go through the Report in detail.

**[Back one step](#)**

Responses by the Swedish Aviation Administration, Aviation Safety Authority, to the recommendations contained in the Report on Incident to SE-DRE on 12 November 1999.

## Luftfartsverket

JAA,  
Operations Director,  
Mr G Rebender,  
PO Box 3000,  
2130 KA Hoofddorp,  
The Netherlands.

Date 16 December 2002

Dear Sir,

**Proposal for a review of JAR OPS 1, Subpart D – use of oxygen**

Experience from investigations of occurrences involving the more subtle forms of smoke or fumes on-board an aircraft during flight, has led us to believe that it may not be apparent to the flight crew that there is a need to use oxygen or PBE:s. These situations could result in degradation of the capacity of the crew members without them becoming aware of this. It may therefore be appropriate to include in JAR-OPS a requirement to treat situations involving smoke, fumes, contamination of the air, or suspicion of any of these, with appropriate sincerity and without undue delay. Such actions may include the use of non-normal/emergency checklists, use of oxygen/PBE, etc.

With reference to the above, I ask that the OPSP-ST be tasked to study this matter and to evaluate the need to supplement JAR-OPS and to propose appropriate action.

The situations referred to involve pressurised aeroplanes, where the problems are deemed to be more severe than with non-pressurised aircraft. The relevant investigation report is attached for information.

Best regards  
Bo Eckerbert  
Head of Regulation Services

JAA,  
PO Box 3000,  
2130 KA Hoofddorp,  
The Netherlands.

Date 28 April 2003

Dear Sir,

At the end of 1999, the crew (cabin and flight deck) of a BAe 146, in Swedish domestic operations, experienced problems which were suspected to be attributed to pollution of air. This happened on three flights and although these three flights were performed with the same aeroplane, the findings by the Swedish Board of Accident Investigation (SHK) are felt to be of a general nature, which is confirmed by similar occurrences elsewhere.

The detailed causes and recommendations by SHK are contained in the attached copies of the investigation report and the records of the meeting by the Swedish Aviation Safety Authority.

As recommended by SHK, we submit this material to JAA with a proposal that

- Recommendation No 1 is sent to the JAA OST for a review of how checklists and training programmes can ensure that adequate measures are taken by the crew as soon as air pollution is suspected;
- Recommendation No 2 is sent to the relevant medical expertise for consideration, in co-operation with the OST, of plans that will be adequate to treat the crew in case of incidents involving polluted air. The recommendation also involves plans on how to take care of the aircraft after incidents of this kind. Such plans will typically include identification and elimination of the kind and source of the air pollution. This is likely to be a task for the CST and/or the MST;
- Recommendation No 4 is sent to the JAA Research Committee for their consideration of adequate research efforts related to the possible influence of modern lubrication oils in the health of human beings.

We submit this material for consideration by the JAA on appropriate activities. It should be mentioned, with reference to the investigation report, that the AAIB, UK, has made similar recommendations.

Kind regards  
Bo Eckerbert  
Head of Regulation Section

Swedish Civil Aviation Administration  
Aviation Safety Authority  
SE-601 79 Norrköping, Sweden.

Session date 2001-12-04

Issue – Session regarding accidents and incidents: SE-DRE, incident 1999-11-12

The incident has been investigated by the Board of Accident Investigation, SHK. The investigation is analysed in RL 2001:41, issue L 102-/99

#### Aircraft

SE-DRE, BAe 146-200. No damage was inflicted on the aircraft.

#### Owner/proprietor according to the aircraft register

The aircraft was operated by Braathens Malmö Aviation at the time of the incident.

#### Date and place of occurrence

12<sup>th</sup> of November, 1999, in the airspace north of Malmö/Sturup's airport.

#### Passengers and crew

5 crew members and 68 passengers.

Neither crew nor passengers were submitted to any injuries.

Mr. Danielsson presented the investigation report in brief. The report was discussed.

The following recommendations were provided by the Board of Accident Investigation, SHK:

“The Swedish Civil Aviation Administration is recommended to work in consultation with the foreign civil aviation authorities concerned to encourage:

- that existing emergency checklists and emergency training programmes are complemented regarding immediate steps to be taken when suspicion arises that the cabin air is polluted. The instruction for such occasions shall call for the immediate use of the oxygen mask selected to 100% (RL 2001:41e R1)
- 
- that a plan of action is developed for how crews and aircraft shall be handled directly after landing if an incident with polluted cabin air has occurred (RL 2001:41e R2)
- 
- that an international database is established with factual information from flights where suspicion of polluted cabin air exists (RL 2001:41e R3) and;
- 
- that research efforts are initiated in regards to the characteristics of modern lubricating oils under very high pressure and temperature and their influence on the health of human beings (RL 2001:41e R4).”

### Record Notes

The Swedish Aviation Safety Authority notes that the operator has taken actions according to the recommendations No. 1 and No.2 from the Board of accident Investigation, SHK, after the incident.

### The decision of the Swedish Aviation Safety Authority

In the light of the proportions of the actions that have to be taken in order to engage foreign civil aviation authorities, aircraft manufacturers and operators, the Swedish Aviation Safety Authority considers that the purpose of the recommendations is achieved through the actions listed below.

### Recommendation No.1 of the Board of Accident Investigations, SHK

The Flight Operations, Aerodromes and ANS Section was tasked to submit a written report to the JAA Operations Committee, containing suggestions on how this type of measure shall be dealt with in JAR-OPS 1.

(R1 Task1). The completion of the task shall be reported to the Chairman not later than March 31,2002.

On an international level, the recommendation will also be handled through recommendation no.2001-47 from the Board of Accident Investigation, UK, which contains the same intent as the recommendation from the Swedish Board of Accident Investigation, SHK. Since the Civil Aviation Authority, UK, is responsible for the type certificate, the recommendation will reach the manufacturer concerned.

### Recommendation No.2 of the Board of Accident Investigation, SHK

The Aviation Training and Licensing Section was tasked to evaluate the recommendation and to look into practical solutions. The Swedish Aviation Safety Authority will take a definitive position regarding the recommendation when incoming reports have been analysed.

(R2 Task 1). The completion of the task shall be reported to the Chairman not later than March 31, 2002.

### Recommendation No.3 of the Board of Accident Investigation, SHK

The recommendation will be taken care of through the commencement of operation of the European database, ECCAIRS, where accidents, incidents and occurrences are reported. ECCAIRS will also be put into operation by ICAO, for the handling of accident and incident reports from the Member States. The recommendation is herewith considered as adequately dealt with.

### Recommendation No.4 of the Board of Accident Investigation SHK,

The Flight Operations, Aerodromes and ANS Section was tasked to write to the JAA Research Committee and act for the recommendation to be taken into consideration in forthcoming research projects.

(R4 Task 1). The completion of the task shall be reported to the Chairman not later than March 31, 2002.

The recommendation is also handled through the recommendation No. 2001-6 of the Board of Accident Investigation, UK, which is related to the Civil Aviation Authority, UK responsibility as the type certificating authority.

### Other

The Flight Operations, Aerodromes and ANS Section was tasked to inform of this occurrence at the forthcoming seminar in February 2002, for Nominated Postholders – Flight Operations (Other, Task 1)

The Aviation Training and Licensing Section was tasked to inform, in an appropriate way, all the authorised medical examiners (AME's) about this occurrence and to encourage the operators to include, in their instructions (attachment number 6 in the report), information on measures to be taken in the event of a similar situation occurring in the future (Other, Task 2).

The Analysis and Standards Section was tasked to send a copy of the report and this record to the Civil Aviation Administration, UK, (Other, Task 3).

The completions of the task 1-3 shall be reported to the Chairman not later than March 31, 2002.

The Analysis and Standards Section was tasked to contact the Civil Aviation Authority, UK, about the measures taken as a result of the recommendations of the Board of Accident Investigations, UK (Other, Task 4). The completion of the task shall be reported to the Chairman not later than December 31 2002.

Based on the reports from each task, it may be necessary to take further measures regarding flight safety. This shall be carried out through a meeting that will take place as soon as the completed tasks have been submitted to the Chairman. The Analysis and Standards Section was assigned to assemble this meeting (Other, Task 5).

The legal aspects of licenses and responsibility were discussed, however, the Swedish Aviation Safety Authority decided not to take any actions.



Flight Operations Department, Aviation House, Gatwick Airport South, Gatwick West Sussex, RH6 0YR

**17/2000**

## **IN THIS ISSUE**

- 1 P-RNAV PROCEDURES
- 2 LICENCE SKILL TESTS (LST)/LICENCE PROFICIENCY CHECKS (LPC): INSTRUCTIONS TO AUTHORISED EXAMINERS
- 3 INCAPACITATION PROCEDURES
- 4 CRM INSTRUCTOR ACCREDITATION - INDUSTRY FORUM

## **1 P-RNAV PROCEDURES**

- 1.1 JAA Admin and Guidance Material, Section One, General Part 3, Temporary Guidance Leaflet (TGL) No.10: Airworthiness and Operational Approval for Precision RNAV Operations in Designated European Airspace, was published on 1 November 2000. The leaflet gives guidance on the conditions that need to be met, both in respect of airworthiness and operational procedures in order to gain approval for use of P-RNAV operations. The purpose of this communication is to give further guidance and to outline the method of obtaining approval for UK operators.

### **1.2 Aircraft Flight Manual**

The TGL gives guidance on the functional requirements for airworthiness approval but a statement in the Aircraft Flight Manual (AFM) authorising the use of P-RNAV is a prerequisite for operational approval.

### **1.3 Approval Procedure**

- 1.3.1 There is a need to distinguish between conventional SIDs and STARs which have been overlaid with RNAV coding and those which have been specifically designed for RNAV. Annex C of the TGL (copy attached) distinguishes between the various types of procedures.

- 1.3.2 Approval of RNAV procedures that have been designed using conventional aids but have been overlaid with RNAV coding (cases (b) or (c) of Annex C).

There is no special approval needed for these types of arrival or departure procedures. The procedures are designed using conventional aids. Raw data from these aids must be used as a back up and as a gross error check. The procedure for achieving this must be clearly stated in the Operations Manual and the crew must have received appropriate training in the use of these procedures including contingency procedures in the event of RNAV system failure and reversion to conventional navigation. Provided that these procedures are included in the Operations/Training Manual and have been accepted by the assigned Flight Operations Inspector (FOI), then no further approval is necessary.

- 1.3.3 Approval of procedures designed to be flown using RNAV (cases (d) and (e) of Annex C).

## FLIGHT OPERATIONS DEPARTMENT COMMUNICATION - 17/2000

---

In order to gain approval for the above procedures it will be necessary to demonstrate full compliance with the TGL. Checks will be made to this effect to include entries in the Operations/Training Manual, training as described in Table 3 of the TGL and method of ensuring the integrity of the data base used.

## FLIGHT OPERATIONS DEPARTMENT COMMUNICATION - 17/2000

---

- 1.3.4 There are no RNAV arrival and departure procedures in the UK at the moment but these will be introduced in the future and will be available to suitably equipped and approved aircraft. Some areas of Europe already employ these procedures and UK operators will need to be approved in order to use them. Requests for approvals should be made through the assigned FOI in the first instance. This P-RNAV approval does not cover the use of RNAV approaches which are the subject of a separate approval.

## 2 LICENCE SKILL TESTS (LST)/LICENCE PROFICIENCY CHECKS (LPC): INSTRUCTIONS TO AUTHORISED EXAMINERS

- 2.1 CAA Document 24 gives guidance to Authorised Examiners on the conduct of Type Rating Skill Tests and Proficiency Checks for Multi-Pilot Aeroplanes. This document is being reissued and it was hoped that a number of anomalies between it and JAR-FCL 1 would be removed. However, this has not been possible in all cases and a number of differences remain. Therefore, when conducting Skills Tests and Proficiency Checks for UK licences and JAR licences for UK pilots, examiners should continue to follow the guidance given in Document 24. Of particular note is the requirement to achieve a partial pass which remains at five or less items failed rather than two or less sections failed as in JAR-FCL 1. Note that this is a different criteria for a partial pass to that required for Single-Pilot Aeroplanes.
- 2.1.1 The Civil Aviation Authority has proposed NPA action to the JAR-FCL committee which will, hopefully, remove these anomalies.

### 2.2 Repeats

Examiners are reminded that they may repeat an item **once** only. The option to repeat any item is at the discretion of the examiner and is not a right of the candidate. As a general guidance the examiner should only repeat an item when he considers that the applicant has made a minor error that can be corrected by debriefing. If the item is not completed satisfactorily at the second attempt then it must be recorded as a fail. In this case the retest requirements cannot be ascertained until the end of the test when the total number of items failed is known.

## 3 INCAPACITATION PROCEDURES

- 3.1 There have been a number of recent incidents where, due to smoke or fumes entering the aircraft, both pilots of a Multi-Pilot aircraft have been affected to the extent that their ability to operate the aircraft may have been impaired. This highlighted two important training points; incapacitation drills and the use of oxygen masks.

### 3.2 Incapacitation Drills

Incapacitation drills have been designed to ensure the continued safe flight of a Multi-Pilot aircraft in the event that one of the pilots becomes incapacitated. The situation where both pilots become incapacitated at the same time has been considered so remote that no procedures have been evolved to cope with the occurrence. However, it may be possible in the event of a malfunction in the engine or air conditioning systems which causes toxic fumes to enter the flight deck as has happened in a recent incident. Operators should, therefore, consider this possibility and provide some guidance to their crews, including cabin staff, to be aware of the chance of such an event.

- 3.2.1 The first action in the event of smoke or fumes in the flight deck should be for the flight crew to don oxygen masks and establish communications.

## FLIGHT OPERATIONS DEPARTMENT COMMUNICATION - 17/2000

---

- 3.2.2 Training Inspectors have noted a reluctance by crews to use oxygen masks when carrying out recurrent training in simulators. Operators should ensure that these masks are worn when the drills require this and that pilots regularly practise donning the masks so that they are able to put them on quickly in difficult situations. Routine training/checking should include approaches flown with oxygen masks on.
- 3.2.3 If during line flying it appears that both pilots are suffering from some form of incapacitation or that one pilot appears to be in any way incapacitated for no obvious reason, then the flight crew should don oxygen masks without delay.

### 4 CRM INSTRUCTOR ACCREDITATION - INDUSTRY FORUM

- 4.1 Flight Operations Department Communication 13/2000, which was published on 20 November 2000, included a Letter of Consultation on a proposal to introduce a system of instructor accreditation for instructors of Crew Resource Management.
- 4.2 The letter contained a Regulatory Impact Assessment which invited comments from interested parties to be sent to the CAA before 15 January 2001. Further to this consultation process the CAA plans to hold an Industry Forum at Aviation House, Gatwick on 20 February 2001.
- 4.3 The purpose of the forum will be to provide an opportunity for interested parties to discuss their views on the proposal. There will also be an opportunity to ask questions and seek further guidance on the implementation of the proposals from the CRM Advisory Panel and CAA personnel.
- 4.4 Representatives of interested parties wishing to attend the forum should register using the attached form. There is no fee for attendance but places may be limited.

**Captain D J Chapman**  
**Head Flight Operations Department**  
**28 December 2000**

**IT IS STRONGLY RECOMMENDED THAT OPERATIONS DEPARTMENTS BRING THE CONTENTS OF THIS FODCOM TO THE ATTENTION OF THEIR "IN HOUSE" OR CONTRACTED MAINTENANCE ORGANISATION**

## FLIGHT OPERATIONS DEPARTMENT COMMUNICATION - 17/2000

---

### EVOLUTION FROM CONVENTIONAL TERMINAL AIRSPACE PROCEDURES TO RNP-RNAV (ANNEX C)

There are a number of steps envisaged in the transition from today's conventional terminal airspace procedures to future RNP-RNAV procedures:

**(a) Conventional Procedure**

A conventional procedure design (VOR radials, NDB bearings and DME fixes/arcs, ILS, MLS). Flown with conventional means (VOR, DME, ADF, ILS and MLS).

**(b) Conventional Procedure flown by an RNAV system coded to ARINC 424**

A conventional procedure design but stored in a navigation database using the full set of ARINC 424 Path Terminators (currently 23 different leg types).

**(c) Conventional Procedure meeting RNAV criteria**

A conventional procedure designed specifically to meet RNAV criteria using sensors such as VOR/DME, DME/DME and GNSS. This procedure is published as a conventional procedure and may reference VOR radials, NDB bearings and DME fixes. However, it will have associated waypoints to define the RNAV path. This removes the ambiguity/approximations found in conventional procedures of paragraph (b), when flown using RNAV systems and ensures repeatability of the intended path over the ground.

**Note:** This is the first step towards achieving predictable track-keeping resulting from consistent and correct coding in the navigation databases, published waypoints and the application of fly-by turns. This can be used as a learning period for designers, chart and AIS providers, introducing as it does the concepts of path terminators, procedure validation, database issues, charting and publication issues.

**(d) RNAV Procedure (Not RNP)**

A procedure designed specifically for RNAV using sensors such as DME/DME, GNSS and VOR/DME. Use is made of waypoints located according to minimum distance requirements as laid down in PANS-OPS. This procedure is identified as an RNAV procedure and the sensor used for the design must be published. The procedure is intended for Precision RNAV or RNP-RNAV certified systems.

**(e) RNP-RNAV Procedure**

A procedure designed according to RNP-RNAV criteria. This procedure is identified as RNP-RNAV and may be used for all applicable sensors, and is protected as such. The procedure is intended for RNP-RNAV certified systems.

The conventional procedure of paragraph (a) was originally designed for hand-flown operations and does not always lend itself to the use of RNAV systems. Navigation database providers have had to interpret the procedure specification using the leg types available in the full ARINC 424 tool kit. This has resulted in the need for additional fixes (Computer Navigation Fixes (CNF)) to be defined in order to construct a best fit to the procedure path. In general, these aspects are transparent to ATC, but can result in path deviations under given conditions of aircraft type, configuration (weight, CG), FMS manufacturer, and wind. The RNAV system, whilst commanding path steering, may be restricted by built-in bank angle or performance limits. The consequence of such limits may be a path deviation which may be recovered automatically or may require pilot intervention.

## FLIGHT OPERATIONS DEPARTMENT COMMUNICATION - 17/2000

---

At all times, the conventional procedure, be it coded according to ARINC 424 or not, may be monitored by the flight crew against raw radio aid data, and the integrity of the navigation database is not really an issue. From the aircraft perspective, the safety of flight envelope is maintained, although separation from obstacles or other traffic may be lost. Hence, the major concern with these types of procedures is their compatibility with the RNAV system and how well the procedure can be flown under all conditions for all aircraft types. It would be preferable for conventional procedures to be designed to take into account the limitations and constraints of the RNAV system.

When P-RNAV is subsequently mandated, the underlying conventional procedure may be withdrawn leaving a stand-alone RNAV procedure.

The RNP-RNAV procedures of paragraph (e) are expected to be introduced initially to take advantage of the reduced obstacle clearance requirements associated with RNP<1 instrument procedures and RNP MASP compliant systems. They are expected to replace all RNAV procedures.

**FLIGHT OPERATIONS DEPARTMENT COMMUNICATION - 17/2000**

---

**CRM INSTRUCTOR ACCREDITATION INDUSTRY FORUM  
TO BE HELD ON TUESDAY 20<sup>TH</sup> FEB. 2001 AT  
AVIATION HOUSE, GATWICK**

**Please complete and return as soon as possible**

**Name:** \_\_\_\_\_

**Address:** \_\_\_\_\_

**Phone:** \_\_\_\_\_ **Fax:** \_\_\_\_\_ **e-mail:** \_\_\_\_\_

**Car Reg:** \_\_\_\_\_

Registration & Coffee in Atrium @ 1000 hrs

Conference Starts @ 1030 hrs

Lunch 1230 - 1330 hrs

Afternoon Refreshments 1445 hrs

**Please return completed form to:**

Mrs Pat King  
Civil Aviation Authority  
Flight Operations Standards  
Aviation House  
Gatwick Airport South  
West Sussex  
RH6 OYR

**ALL REGISTRATION FORMS TO BE RECEIVED BY  
FRIDAY 9<sup>TH</sup> FEBRUARY.**



Flight Operations Department, Aviation House, Gatwick Airport South, Gatwick West Sussex, RH6 0YR

14/2001

## IN THIS ISSUE

- 1 AAIB RECOMMENDATIONS FOLLOWING TWO SERIOUS INCIDENTS INVOLVING BRITISH REGISTERED AIRCRAFT UNDERTAKING PUBLIC TRANSPORT FLIGHTS: ONE RELATING TO STROBE LIGHTS, THE OTHER RELATING TO OXYGEN MASKS SELECTED TO 100%
- 2 CAP 712 SAFETY MANAGEMENT SYSTEMS FOR COMMERCIAL AIR TRANSPORT OPERATIONS

- 1 **AAIB RECOMMENDATIONS FOLLOWING TWO SERIOUS INCIDENTS INVOLVING BRITISH REGISTERED AIRCRAFT UNDERTAKING PUBLIC TRANSPORT FLIGHTS: ONE RELATING TO STROBE LIGHTS, THE OTHER RELATING TO OXYGEN MASKS SELECTED TO 100%**

### 1.1 Introduction

- 1.1.1 Following two separate serious incidents involving British registered aircraft undertaking public transport flights, the Air Accidents Investigation Branch (AAIB) of the Department for Transport, Local Government and the Regions made recommendations to the CAA. This FODCOM highlights two of the recommendations and notifies actions which should be taken by operators, where appropriate.

### 1.2 Strobe Lights

- 1.2.1 The first incident occurred at London Heathrow Airport when Runway 09 Right (09R) was being used for take-off and Runway 09 Left (09L) was being used for landing. There was also a local procedure whereby aircraft could land on Runway 09R if traffic conditions allowed. A number of aircraft had been given conditional line-up clearance for Runway 09R and an arriving aircraft was approaching for a landing on Runway 09R.
- 1.2.2 With one aircraft still on the runway for take-off, the approaching aircraft was instructed to go-around at a late stage. During this procedure, the aircraft performing the go-around descended to 118 feet radar altitude above the runway; the aircraft on the runway for departure had a tail fin height of 38 feet 7 inches.
- 1.2.3 As a result of their investigation the AAIB made a number of recommendations including the following:-  
  
The Civil Aviation Authority should issue instructions requiring United Kingdom Registered aircraft to use strobe lights, if fitted, when on an active runway in the UK.
- 1.2.4 The CAA has accepted this recommendation. Initial investigations show that many operators already use their strobe lights in such circumstances. In addition, the CAA feels that the recommendation should apply to all runways, not just those in the UK.
- 1.2.5 **You should review your operating procedures and amend your Operations Manual as necessary to include instructions that, if fitted, strobe lights should be used when on an active runway prior to take-off or after landing.**

### 1.3 Oxygen Masks

- 1.3.1 The second incident involved an aircraft in which two passengers noticed an "oily petrol" smell. In addition, a positioning company cabin crew member had also reported a similar smell.
- 1.3.2 The aircraft commander asked the senior cabin attendant to go to the rear of the passenger cabin to check the situation. She did so and reported that she could detect nothing unusual. The commander then instructed her to advise him if there were any further indications.

## FLIGHT OPERATIONS DEPARTMENT COMMUNICATION - 14/2001

---

- 1.3.3 However, later in the flight, both pilots began to feel ill. The commander noticed that the first officer's face was white and that his pupils appeared highly dilated.
- 1.3.4 The commander took the handling duties, instructed the first officer to put on his oxygen mask and called the senior cabin attendant to the flight deck. The commander instructed her to check the flight deck regularly during the descent and approach. Thereafter, the first officer took no part in the conduct of the flight although he was able to nod in response to the commander's questions.
- 1.3.5 By this stage, the aircraft was at FL70 and positioning for an ILS approach. Although the commander began feeling progressively worse, he was able to continue the approach and landing.
- 1.3.6 Following their investigation the AAIB made a number of recommendations including the following:-

The Civil Aviation Authority should consider issuing additional advice to the crews of jet transport aircraft on the best operational practice when there is a suspicion of flight deck or cabin air contamination. The advice should include the necessity for all flight crew to use oxygen masks selected to 100% and the importance of cabin crew taking an active part in monitoring the flight crew in such circumstances.

- 1.3.7 **FODCOM 17/2000, dated 28 December 2000, contains advice on incapacitation procedures. Operators are further reminded that Operations Manual procedures should contain detailed instructions to crews on such procedures. These should at least include the necessity to use oxygen masks at 100% whenever contamination is present or suspected and the need to establish communications by the appropriate switch selections. Additionally, cabin crew procedures should include monitoring of the flight deck. However, this should not be to the detriment of other emergency procedures such as dealing with cabin smoke or fires, especially where only one cabin crew member is carried.**
- 1.3.8 Operators should also ensure that incapacitation procedures are regularly practised during recurrent training and that case based studies are discussed at joint flight deck/cabin crews safety training.

## **2 CAP 712 SAFETY MANAGEMENT SYSTEMS FOR COMMERCIAL AIR TRANSPORT OPERATIONS**

- 2.1 The above mentioned document is the product of the joint Air Transport Operators/SRG working group and provides practical guidance on the development and implementations of Safety Management Systems in airline and maintenance organisations.
- 2.2 CAP 712 can be purchased for £10.00 per copy from Documedia Ltd, 37 Windsor Street, Cheltenham, Gloucestershire, GL52 2DG. Telephone 0870 887 1410. Fax 0870 887 1411.

It is also available on the CAA website:

[http://www.srg.caa.co.uk/publications/cap712\\_sms\\_for\\_commercial\\_air\\_transport\\_operations.pdf](http://www.srg.caa.co.uk/publications/cap712_sms_for_commercial_air_transport_operations.pdf)

Captain D J Chapman  
Head Flight Operations Department  
24 August 2001

*Recipients of new FODCOMs are asked to ensure that these are copied to their 'in house' or contracted maintenance organisation, to relevant outside contractors, and to all members of their staff who could have an interest in the information or who need to take appropriate action in response to this Communication.*

SAFETY REGULATION GROUP

# FLIGHT OPERATIONS DEPARTMENT COMMUNICATION



Flight Operations Department, Aviation House, Gatwick Airport South, Gatwick West Sussex, RH6 0YR

21/2002

## IN THIS ISSUE

- 1 UK PUBLIC TRANSPORT SMOKE/FUMES OCCURRENCES
- 2 EMERGENCY PROCEDURES FOR CABIN ALTITUDE WARNING

### 1 UK PUBLIC TRANSPORT SMOKE/FUMES OCCURRENCES

#### 1.1 Introduction

- 1.1.1 The rise in the number of reported smoke/fumes events on UK Public Transport aircraft is viewed by the Civil Aviation Authority (CAA) as a potentially serious issue. This FODCOM looks at these events in more detail. Four aircraft types noted to have a higher than normal history of smoke/fumes events were selected for comparison. Only UK Public Transport reported events have been examined.

#### 1.2 History

- 1.2.1 Between 1990 and 2001, there were 263 reported smoke/fumes events on the four selected aircraft types. Approximately 25% of these occurrences resulted in the crew or passengers suffering some degree of physical discomfort such as nausea, sore throats and light-headedness. On rare occasions, and only on two aircraft types, flight crew have been incapacitated to a greater or lesser degree.
- 1.2.2 For each of the four aircraft types there have been some aircraft that have reported more than one smoke/fumes event in the 12 year period studied. For example, there were 113 events recorded by 65 aircraft of the same type with 30 aircraft reporting two or more events. The maximum number of events recorded by individual aircraft in the time period studied was five. There are several cases of an individual aircraft reporting two or more events in a relatively short time period (e.g. a particular aircraft that reported three events in eight weeks) perhaps indicating that the causes of these events are difficult to identify.
- 1.2.3 The rate of reported events on all four aircraft types has been increasing in recent years.

#### 1.3 Actions Taken, Ongoing and Planned

- 1.3.1 In December 2000 a Flight Operations Department Communication (FODCOM 17/2000) was issued recommending that flight crew don oxygen masks as the first action in the event of smoke or fumes on the flight deck. This FODCOM is applicable to all UK operators regardless of aircraft type.
- 1.3.2 In August 2001, FODCOM 14/2001 was published as a reminder and to expand on the instructions previously given.
- 1.3.3 With respect to one of the aircraft types:
  - a) In December 2000, the manufacturer issued an All Operators Memorandum (AOM) that instructed donning of oxygen masks when fumes or smells are evident or when there is a suspicion of a contaminated cockpit air supply. That was followed with a CAA approved Flight Manual change mandating the early donning of oxygen masks.

**FLIGHT OPERATIONS DEPARTMENT COMMUNICATION - 21/2002**

---

- b) In January 2001, the same manufacturer issued a Service Information Letter defining "best practice" troubleshooting procedures in case of smoke or fumes events.
  - c) In March 2001 the CAA issued an Airworthiness Directive imposing frequent inspections on this aircraft type for wet oil contamination of the air conditioning packs. If oil contamination is found, then the AD mandates further actions in terms of cleaning packs, and inspection and rectification of engine and APU oil leaks.
  - d) Further actions are in preparation, both at the aircraft level and at the engine level.
- 1.3.4 With respect to another of the aircraft types:
- a) The CAA has prompted a series of meetings between an affected operator, the aircraft manufacturer and the engine manufacturer to discuss air quality.
  - b) The evidence available to date indicates that only one operator of this aircraft type is suffering this phenomenon and then almost exclusively to aircraft powered by one particular model of engine. A team of all parties has defined an enhanced standard of engine rebuild practices to reduce incidence of oil leakage to the cabin bleed. This is now required for all relevant engine shop visits. In addition revised oil filling procedures are to be introduced and the manufacturer is active in defining the specific troubleshooting procedures to follow after an event. The operator has instructed the immediate donning of oxygen masks and developed its own enhanced troubleshooting techniques for the interim.
- 1.3.5 The actions taken and planned are considered reasonable for the interim, commensurate with the risk. The probability of future events is being minimised by the likely source being addressed (oil leakage) and by the severity of the effect at the flight deck being reduced (donning masks). Nevertheless, the CAA will continue to encourage the manufacturer for modifications at the aircraft level to eliminate the threat.
- 1.3.6 The actions taken by the CAA and industry as described above, appear to have made an impact on the rates of the reported high risk smoke/fume events. This is under constant review.
- 1.3.7 To try to better understand the phenomenon, the CAA is sponsoring research activity that investigates contamination products from engine oil that could represent a hazard to flight deck crew. The purpose is to make a general assessment of the toxic potential of the components and thermal degradation products of a synthetic ester gas turbine lubricant and contamination within the Environmental Control System. This work complements type specific investigations being conducted by the manufacturers. This data is being analysed to try to identify any toxicological links with the symptoms being reported.
- 1.3.8 The problem of smoke/fumes on UK Public Transport aircraft is now one of the subjects contained in the CAA Safety Regulation Group (SRG) Safety Intervention Programme and is detailed in the SRG Business Plan under the title of Hazardous Contamination of Flight Deck Cabin Air. Work is already well advanced on this subject and one task under this initiative involves a review of the service history for all UK registered large aeroplane types to identify the need for further continued airworthiness actions. In addition, the CAA is to support an FAA/JAA/Industry working group that is tasked to investigate this issue within its broader review of the design requirements related to the cabin environment.
- 1.3.9 Although the exact cause of crew incapacitation is not yet known, the most probable source is oil leaking from the engines or APU and contaminating the air supply to the cabin and cockpit through the air conditioning system. CAA specialists believe that reducing occurrences of oil contamination will also reduce the risk of flight crew incapacitation. Nevertheless, investigations continue and further mandatory actions will be taken if found necessary.

**FLIGHT OPERATIONS DEPARTMENT COMMUNICATION - 21/2002**

---

**1.4 Summary**

1.4.1 For reasons not fully understood there has been an increase in the number of events reported to the CAA during which aircraft occupants have been exposed to fumes and/or smoke. Advice to flight crew on how to deal with the immediate risks was given in FODCOMs 17/2000 and 14/2001. Research is continuing to identify the causes, however these are proving to be elusive.

1.4.2 FODCOM 17/2000 contained two Recommendations:

- a) The first action in the event of smoke or fumes in the flight deck should be for the flight crew to don oxygen masks and establish communications.
- b) If during flight it appears that both pilots are suffering from some form of incapacitation or that one pilot appears to be in any way incapacitated for no obvious reason, then the flight crew should don oxygen masks without delay.

1.4.3 FODCOM 14/2001 also contained two Recommendations:

- a) FODCOM 17/2000, dated 28 December 2000, contains advice on incapacitation procedures. Operators are further reminded that Operations Manual procedures should contain detailed instructions to crews on such procedures. These should at least include the necessity to use oxygen masks at 100% whenever contamination is present or suspected and the need to establish communications by the appropriate switch selections. Additionally, cabin crew procedures should include monitoring of the flight deck. However, this should not be to the detriment of other emergency procedures such as dealing with cabin smoke or fires, especially where only one cabin crew member is carried.
- b) Operators should also ensure that incapacitation procedures are regularly practised during recurrent training and that case based studies are discussed at joint flight deck/cabin crews' safety training.

1.4.4 The potential for a smoke/fumes event to adversely affect the subsequent operating effectiveness of the flight or cabin crew must be considered. In order to ensure that, as far as possible, the operating effectiveness of the crew is not reduced, the CAA recommends that the operator should take the following actions.

**1.5 Further Recommendation**

1.5.1 Operators should ensure that flight crews are aware that the first action in the event of smoke or fumes in the flight deck should be for the flight crew to don oxygen masks and establish communications.

1.5.2 Operators should ensure that flight and cabin crew are advised as to the post-flight actions required following a smoke/fumes incident. These actions should include:

- a) A Commander's review of the in-flight incident. This should include consultation with the flight and cabin crew;
- b) A determination as to whether any crew member felt unwell, or whether their performance was adversely affected; and
- c) The requirement for a crew member who felt unwell, or felt their performance was affected, not to operate as a member of the crew until he/she has been assessed as fit by a medical practitioner and the crew member feels fit to operate.

1.5.3 The instructions to flight and cabin crew should be detailed in the Operations Manual.

**FLIGHT OPERATIONS DEPARTMENT COMMUNICATION - 21/2002**

---

**2 EMERGENCY PROCEDURES FOR CABIN ALTITUDE WARNING****2.1 Introduction**

- 2.1.1 In October 1999 a Learjet 35 en route from Orlando to Dallas ran out of fuel and crashed in South Dakota. The lack of the Learjet flight crew's response to air traffic raises the possibility of flight crew incapacitation caused by a problem with the pressurisation system.

**2.2 Findings**

- 2.2.1 A Special Certification Review conducted by the Federal Aviation Administration (FAA) has discovered that some Aeroplane Flight Manuals (AFMs) do not have an emergency procedure that requires donning the flight crew oxygen masks as an immediate action when the cabin altitude aural warning is activated. However some AFMs do contain an abnormal procedure that allows the flight crew to troubleshoot the pressurisation system prior to donning the oxygen masks after the altitude warning sounds. This troubleshooting may delay the donning of the oxygen masks to the point that the flight crew may become incapable of donning their oxygen masks.

**2.3 Action Taken**

- 2.3.1 One major large aircraft manufacturer has produced an Airworthiness Directive (AD) to require that AFMs are revised to advise the flight crew to don oxygen masks as a first and immediate action when the cabin altitude warning sounds. This action is considered necessary to prevent the possibility of flight crew incapacitation due to lack of oxygen, which could result in loss of control of the aeroplane. The FAA has proposed the adoption of this AD in a Notice of Proposed Rulemaking.

**2.4 Recommendation**

- 2.4.1 Operators should review their operating procedures and, where necessary, amend their Operations Manuals to ensure that the emergency procedure to be followed in the event of a cabin altitude warning sounding includes, as the first and immediate action, the donning of the flight crew oxygen masks and the establishment of communications.

CAPTAIN D J CHAPMAN  
Head Flight Operations Department  
29 August 2002

*Recipients of new FODCOMs are asked to ensure that these are copied to their 'in house' or contracted maintenance organisation, to relevant outside contractors, and to all members of their staff who could have an interest in the information or who need to take appropriate action in response to this Communication.*