



ATTACHMENT 1

AIRWORTHINESS GROUP CHAIRMAN'S FACTUAL REPORT

NTSB No. CEN17FA252

**FAA Memoranda of MBB Bo-105 Fuel Starvation
Accidents and Recommendations
(12 Pages)**

cc: S. Snow

DEC 16 1992

ACTION: FAA Safety Recommendation
92.292 through 92.294, AAI-200 Memo of 10/14/92

Manager, Rotorcraft Directorate,
Aircraft Certification Service, ASW-100

Manager, Recommendation and Quality
Assurance Division, AAI-200

We have evaluated the safety recommendations submitted in your memorandum of October 14, 1992. We do not concur with the recommendations for the reasons contained herein and do not anticipate any further regulatory action.

Recommendation 92.292

This recommendation proposes that when the dual controls are removed from a BO-105 series helicopter used in Part 135 operation, a clear barrier be installed to prevent a passenger's loose clothing and/or movement from contacting the center pedestal switches, radio, etc.

It has been common practice for all helicopters certificated for single pilot operation to allow passengers to be carried in any seat not occupied by the pilot. In all helicopters, this may put them in close proximity to various switches controls, etc. There is no documented service history which would indicate a safety issue has developed.

While this recommendation indicates it may be a good idea, it is not supported by factual evidence that an unsafe condition exists. Therefore, we do not concur with the recommendation.

Recommendation 92.293

This recommendation proposes that an aural warning device be installed in conjunction with the existing low fuel warning light.

The low fuel warning system was evaluated when the helicopter was certificated. It was determined that it met the Federal Aviation Regulations (FAR) requirements. This includes the evaluation of the size of the warning light and its physical location in the pilot's field of view. We have no objection to operators taking specific approved actions to improve upon the certificated design, however, service history does not warrant the mandated implementation of this action. Therefore, no regulatory action is justified.



U.S. Department
of Transportation
**Federal Aviation
Administration**

Memorandum

Subject: ACTION: FAA Safety Recommendations
93.428 through 93.433

Date: : NOV 12 1993

From: Manager, Recommendation and Quality
Assurance Division, AAI-200

Reply to
Attn. of:

To: Manager, Rotorcraft Directorate, ASW-100

We are in receipt of the attached FAA Safety Recommendations which fall within your area of responsibility for evaluation.

These recommendations have been assigned numbers 93.428 through 93.433. Please refer to these numbers in all future correspondence.

The fuel system design of the MBB BO-105 has been the subject of previous FAA safety recommendations. In addition to requesting reconsideration of the FAA Safety Recommendations 91.249 and 91.250, the submitter proposes additional recommendation relevant to the MBB BO-105. These recommendations stem from five accidents involving the MBB BO-105, including three fatal accidents, in which the fuel boost/transfer pump switches were improperly placed. Given the large number (184) of MBB BO-105's in operation worldwide, we believe that Safety Recommendations 93.428 through 93.433 have merit.

Within 90 days of receiving these recommendations, you are required to send a response to AAI-210 outlining the action that has been taken or is planned. If you have any questions or need additional information regarding these issues, please notify Mr. Jeff Gorney, AAI-210 (267-8748) as soon as possible.

We appreciate your support in the FAA Safety Recommendation Program and your efforts to resolve these safety issues as quickly and completely as possible.


Frank S. Del Gandio

Attachment



ALASKAN REGION
FLIGHT STANDARDS DIVISION

(907) 271-5514 FAX (907) 276-6207

FAX TRANSMITTAL COVER SHEET

FROM: Gerald Acond

ROUTING: AAL-252 PHONE: [REDACTED]

TO: Jeff Gorney

ROUTING: AAI-200 PHONE: [REDACTED]
FAX [REDACTED]

ROUTINE: _____ PRIORITY: ✓

TOTAL # OF PAGES INCLUDING COVER SHEET: _____

REMARKS: MBB- B0-105 Transfer pump switch problem.

It has come to my attention last week of another Fatal (Crash),

Two serious injuries, Aircraft destroyed Accident caused by fuel starvation

due to the transfer switch being in the wrong position.

Accident occurred 8/13/91 in HONOLULU, HAWAII.

NTSB Accident # LAX91GA356. Recorder Recommendation
Attached 1170-194 # 91.249 and # 91.250

MBB HELICOPTERS BO-105
FUEL SYSTEM PROBLEMS:

MARCH 1, 1993

BY GERALD ACORD
AIRWORTHINESS SPECIALIST
FLIGHT STANDARDS DIVISION
ALASKAN REGION
AAL-252

PURPOSE:

There appears to be a problem with the design of the fuel system of MBB Helicopters/Eurocopters, model BO-105. The problem has been the causation of five known accidents that have resulted in the loss of life, serious injuries and the destruction of aircrafts.

The purpose of this study is to give a basis for re-consideration of Aircraft Safety Recommendations 91.249 and 91.250.

ACCIDENT HISTORY:

On July 14, 1984, a MBB helicopter, model BO-105C, N105CP, performing a Part 135 flight, crashed in Rehobeth, MA, due to engine fuel starvation caused by the boost/transfer pumps selector switches being placed in the improper position. The results was two fatal and two serious injuries and the aircraft destroyed. (NTSB Accident #NYC84FA240)

During 1985 the Drug Enforcement Agency had a MBB Helicopter, model BO-105LS, crash in Hawaii, due to engine fuel starvation caused by the boost/transfer pumps selector switches being placed in the improper position. The results was fatal injury aircraft destroyed. (No FAA/NTSB report)

On February 10, 1991, a MBB Helicopter, model BO-105CBS, N5413D, performing Part 135 flight, crashed in Valdez, AK, harbor due to engine fuel starvation caused by the boost/transfer pumps selector switches being placed in the improper position. The results was one injury, and substantial damage to the aircraft. (NTSB Accident #ANC91LA026)

On August 13, 1991, a MBB Helicopter, model Bo-105LS, N9737N, performing public use aircraft flight, crashed Honokaa, HI. due to engine fuel starvation caused by the boost/transfer pumps selector switch be placed in the improper position. The results was one fatal, two serious injury, one minor injury and the aircraft destroyed. (NTSB Accident #LAX91GA356)

On August 16, 1992, a MBB Helicopter, model BO-105CBS, N295EH, performing Part 135 flight, crashed in the Gulf of Mexico, due to the boost/transfer pumps selector switches being placed in the improper position. The results was substantial damage to the aircraft. (NTSB Accident #STW92LA212)

The flight check list requires that the transfer pump switch be placed in the on position before take-off. It is taught in factory school and in company school of the larger part 135 operators to turn on the transfer switch. It is a known problem that has occurred to BO-105 pilots. Most have realized the mistake upon notice of the low fuel warning light and taken corrective action.

According to the "General Aviation Activities and Avionics Survey 1991" there were 184 MBB Helicopters, model BO-105. These helicopters accumulated an estimated 67,777 total hours flown in 1991.

DESCRIPTION -FUEL SUPPLY SYSTEM:

The task of the fuel supply system is to provide the fuel supply to both engines. The fuel system on the BO-105 is divided into three subsystems: fuel storage, fuel supply, monitoring system.

I. FUEL STORAGE: The BO-105 has two fuel tanks arranged one behind the other. They are located underneath the cargo compartment floor extending from frame 4 rear to frame 10. The main tank located between frame 5 and 10 is connected to the supply tank located forward between frame 4 and 5. They are connected together through two transfer lines and two electric transfer pumps. All fuel that to the engines is taken only from the supply tank, fuel from the main tank is pumped to the supply tank. In early model BO-105's the supply tank had a baffle that divided the tank into two separate sections. This allowed the a engine to be supplied by its respective section of the supply tank. The total fuel capacity of the tanks is 153 gallons with 150 gallon of usable fuel. The aircraft uses approximately 54 gallons per hour of operation with both engines.

II. FUEL SUPPLY: The fuel supply system consists of:

Two(2) TRANSFER PUMPS- Deliver fuel from the main tank to the supply tank via the transfer lines. As long as the supply tank is full, the excess fuel returns to the main tank via the overflow tubes

Two (2) SUPPLY PUMPS- Deliver fuel to the engines via the feed lines.

Two (2) SHUT OFF VALVES- Shuts off the fuel in the engine feed lines.

III. FUEL SYSTEM MONITORING: The standard fuel system monitoring equipment indicates the fuel quantity in the tanks and checks the functioning of the fuel feed system. It consists of the following subsystems: fuel quantity indicating system, low fuel warning system, fuel pressure indication system, fuel filter contamination warning system.

FUEL QUANTITY INDICATING SYSTEM- Fuel quantity indicator is a dual indicator with the main tank fuel quantity indication (left) and supply tank fuel quantity indication (right).

LOW FUEL LIGHT - Indicates that there is 60 kg (approx 19.8 gallons) of fuel remaining in the supply tank. When the light illuminates the fuel in the supply tank will support approximately 20 minutes of flight depending upon power settings of engines. The low fuel warning light is located in the top warning element of the annunciator panel.

TIME LINE OF EVENTS:

7/14/84 Crash of MBB BO-105, N105CP, two fatal, two serious injuries, aircraft destroyed, Part 135 operation.

00/00/85 Crash of MBB BO-105, Drug Enforcement Agency. Public use aircraft flight.

2/10/91 Crash of MBB BO-105, N5413D, one injury, substantial damage to aircraft, Part 135 operation.

8/13/93 Crash of MBB BO-105, N9737N, one fatal, two serious injuries, one minor injury, aircraft destroyed, public use aircraft flight.

8/15/91 Safety recommendation 91-249* and 91-250* submitted to Directorate Headquarters, Southwest Region ASW-1

9/19/91 Memorandum from Regional Administrator, Southwest Region ASW-1 "NO FURTHER ACTION PLANNED" on recommendations.

10/22/91 ERA Helicopters obtains STC 123SW addition of aural warning for low fuel warning system.

10/25/91 Memorandum from Manager, Recommendation & Quality Assurance Division, AAI-200 "Recommendations 91.249 & 91.250 CLOSED, NOT ADOPTED."

8/16/92 Crash of MBB BO-105, N295EH, substantial damage to aircraft, Part 135 operation.

9/14/92 ERA Helicopters modification of all aircraft in fleet. Aural warning system and modification of glare shield.

* NOTE: MBB/Eurocopters has issued two Service Bulletins in reference to moving the position of the low fuel warning light. One of these has been issued recently and ERA Helicopters obtained an STC to add a aural warning signal for the low fuel light both after the recommendations 91.249 & 91.250 were submitted. The Aircraft Accident Investigation Team has made the recommendation that the Drug Enforcement Agency owned MBB aircraft be modified with a warning light which will illuminate when any of the four fuel pump switches are in the "off" position. MBB Helicopters has applied for a Supplemental Type Certificate for fuel pump warning lights for their model BO-105CBS and 105LS. The warning light will be offered as an option on all new MBB 105 series helicopters.

PROBLEMS WITH FUEL SYSTEM:

The problem with the fuel system as outline in safety recommendations 91-249 and 91-250 as submitted to Directorate Headquarters on August 15, 1991, is that it is possible for a aircraft t o have engine fuel starvation with 80 gallons of fuel aboard the aircraft. When the pilot forgets to turn on the fuel transfer pump switch as was the case in the mention aircraft crashes, he will experience fuel starvation to the engine. Normally this occurs at the time he is concerned with transition from ground effect and is also concerned with other aircraft traffic during take-off. His attention is diverted to outside the cockpit as it should be. There is no master caution warning light to give the pilot any indication to look at his annunciator panel.

Also of concern is the factory location of the low fuel light. It is located in the top element of the annunciator panel and the apex of the instrument panel and glare shield. The glare shield extends out to the extent that it interferes with a tall pilot seeing the light, do to angle between the pilots line-of-sight and the low fuel warning light.

OTHER POTENTIAL PROBLEMS:

Further modifications may be indicated for some applications such as remote area operations; offshore, jungle, Alaska, when fuel on board is need to reach a remote refueling location. If the forward transfer pump fails, the aircraft will acquire approximately four (4) gallons of unusable fuel. The fuel will be trapped in the forward area of the main tank since the aircraft flies with a seven (7) degrees nose down attitude. The loss of approximately four (4) gallons of available fuel could make the difference of reaching the refueling location.

If both transfer pumps fail as with the loss of electrical power, the aircraft would acquire an additional eighty (80) gallons of unusable fuel, and only have approximately twenty minutes in which to find a safe landing area. This situation could result in a water landing, a forced landing in the jungle or a forced landing in the arctic tundra.

The potential of a similar fuel management problem in the MBB model BK-117 should be investigated.

RECOMMENDATIONS:

The following are suggested as possible solutions to solve the fuel system problems:

3.408 1. [Make ERA Helicopter's STC 123SW for the installation of a aural low fuel warning mandatory on BO-105 aircraft by the issuance of a Airworthiness Directive.] and

2. [Make MBB Service Bulletin for the reposition of the light mandatory. or

23.429 3. Make a modification to shorten the glare shield mandatory for BO-105 aircraft.]

25.430 4. [Install an interconnect between the main tank and the supply tank, similar to the one between the aft and forward sections of the main tank.]

27.431 5. [Install an interconnect between the main tank and the supply tank with a shut off value using a push/pull - open/close manual control for the pilot to manually operate.]

28.432 6. [Mandatory installation of pressure switches on each transfer pump which will illuminate a caution panel warning light any time there is a loss of fuel pressure.]

29.433 7. [Adopt Safety Recommendations 91.249 and 91.250]

ACTION: FAA Safety Recommendations
93.428 through 93.433; AAI-200 Memo
of 12-12-93

MAR 11 1994

Manager, Rotorcraft Directorate, Aircraft
Certification Service, ASW-100

Manager, Recommendation and Quality
Assurance Division, AAI-200

We have reviewed the information available relative to the safety recommendations submitted in your letter dated November 12, 1993. Our comments are as follows:

93.428 - This safety recommendation suggests that ERA Helicopter's STC 123 SW for the installation of an aural low fuel warning system be made mandatory for the BO-105 helicopter. While an STC for an optional installation of an aural low fuel warning system has been approved, we do not concur that an aural warning device in addition to the low fuel warning light is essential for the continued airworthiness of all BO-105 helicopters.

93.429 - This recommendation suggests either repositioning of the low fuel warning light or to modify the glare shield to insure the illuminated light is not obstructed from the pilot's view. This item was previously submitted as Safety Recommendation 91.249. Our response of September 9, 1991 was that the helicopter was certified with the warning light located in its present location, and certification evaluations found the location to comply with requirements of FARs 27.1321 and 27.1322.

93.430 recommends the installation of an interconnect between the main tank and the supply tank. We do not concur with this recommendation for the following reasons. The division of the BO-105 fuel storage system between the main and the supply tank is a design consideration to insure continuous and uninterrupted fuel flow during all flight maneuvers within the certified flight envelope of the helicopter when the system is functioning in accordance with approved procedures. Adding an interconnect between main and supply tank would negate the design philosophy of the fuel system.

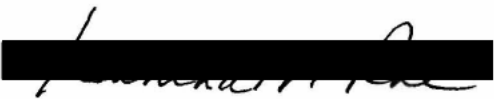
93.431 - This recommendation would install an interconnect between the main tank and the supply tank with a manually operated push/pull shut-off valve. We do not concur with this recommendation for the same reasons submitted for Safety Recommendation 93.430. In addition, the installation of a manually controlled shutoff valve would only complicate the system and make it more prone to pilot error.

93.432 - This recommendation would mandate installation of pressure switches on each transfer pump, which will illuminate a caution panel warning light anytime there is a loss of fuel pressure. While we do not agree with the proposal as recommended, we do concur that the operation of the fuel transfer pumps should be addressed. The manufacturer, Eurocopter Deutschland (ECD) will issue a service bulletin (SB) which will contain the instructions for the "Installation of Main Fuel Tank Pump Switch Off Advisory Light System." This installation will provide a light which will indicate "transfer pumps off" switch position. This SB was scheduled for issue in February 1994.

93.433 - This recommendation suggests the adoption of Safety Recommendations 91.249 and 91.250. We do not agree that the incorporation of these recommendations would help resolve the MBB BO-105 fuel system problems. Our response to these recommendations are contained in the letter dated September 19, 1991 from ASW-1 to ANM-200.

We do not concur with a majority of these recommendations because they are not comprehensive solutions to the fuel system problems. However, we are concerned about this issue. The issuance of the ECD SB for the installation of the "transfer pump off" warning light should alleviate the supply tank low fuel problem.

We will monitor the service history of the installation to determine if it is in fact providing the solution to inadvertent loss of fuel flow to the engine due to low fuel in the supply tank.



James D. Erickson