AAIB Bulletin No: 4/2005 **Ref: EW/G2005/01/01** **Category: 1.1**

INCIDENT

Aircraft Type and Registration:	Saab-Scania AB SF340B, G-LGNH	
No & Type of Engines:	2 General Electric CT7-9B turboprop engines	
Year of Manufacture:	1993	
Date & Time (UTC):	2 January 2005 at 1405 hrs	
Location:	Sumburgh Airport, Shetland Isles, Scotland	
Type of Flight:	Public Transport (Passenger)	
Persons on Board:	Crew - 3	Passengers - 29
Injuries:	Crew - None	Passengers - None
Nature of Damage:	minor damage to bracket requiring a minor repair	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	26 years	
Commander's Flying Experience:	2,134 hours (of which 1,754 were on type) Last 90 days - 90 hours Last 28 days - 32 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and information provided by the operator.	

Synopsis

After an uneventful flight from Aberdeen to Sumburgh, the aircraft was preparing for the return journey, and was parked beside the terminal building, facing into a wind gusting up to 52 kt. After start, as the propeller condition levers were pushed forward, the aircraft pitched backwards and the tail struck the ground. Both engines were shut down and the aircraft settled back to a normal attitude. There were no injuries to the crew or passengers and an engineering inspection revealed only minor damage to a bracket on the bottom of the fuselage used for attaching a tail stand during loading. The likely cause of the accident was an extreme aft centre of gravity caused by incorrect loading of the baggage and the unauthorised relocation of some passengers.

Previous incident

Following a previous incident in which one of its SF340s was found to have been loaded with a baggage mass well in excess of that stated on the loadsheet, the operator decided to use actual baggage weights for all subsequent SF340 operations. ATP aircraft, also operated by the company, continued to use standard, or notional, weights for both passengers and baggage. Handling agents at all scheduled destinations were aware of this procedure. However, as this route was usually operated by an ATP, the handling agent presented the captain with passenger, baggage and cargo weights based on standard weights.

Centre of gravity determination

The captain completed a manual load sheet using the passenger seating positions allocated at check-in. From this he determined a baggage distribution that would enable the aircraft to operate within the company weight and balance envelope. This information was passed to the handling agent, who in turn passed instructions to the loaders. Subsequent inspection of the manual loadsheet revealed an arithmetic error, overestimating the weight of the aircraft by 100 kg, but this had no bearing on the occurrence.

Passenger and cabin crew reports after the event stated that three of the passengers were in fact sitting in Row 13, a row of three seats that is not available in other company SF340s, located in what is usually part of the cargo hold. It was not possible to determine if the passengers had moved with the consent of the cabin crew.

The manufacturer's normal operating aft Centre of Gravity (CG) limit corresponds to 37.7% of the mean aerodynamic cord (MAC). The operator's limit is more restrictive at 35.8% MAC. At its extreme, the CG must remain forward of a position corresponding to 47% MAC to avoid the aircraft tipping onto its tail. Using data provided by the operator, the actual CG was estimated using standard passenger mass and actual baggage mass. With all passengers seated in their allocated seats the aircraft CG would have been located at 37.3% MAC; aft of the operator's CG envelope but within the manufacturer's limit. However, with three passengers seated in Row 13 instead of in their allocated seats, the CG moved to 44.3% MAC; aft of the manufacturer's limit. Furthermore, the cargo net in the forward of the two cargo compartments was found to have been fastened incorrectly, allowing baggage to rest unrestrained against the rear bulkhead. Consequently, it is likely that the actual CG was aft of that determined above, and significantly aft of that calculated at the time. The use of standard passenger weights would probably have introduced additional errors in the estimation of aircraft CG, and it is therefore possible that the aircraft was loaded in such a way that the CG fell aft of 47% MAC (tipping limit). It is unclear what would have been the effects of the strong gusting headwind.

Operator's findings and recommendations

The principal findings of the operator's own investigation were that the handling agent had provided the captain with standard weights and not actual weights as required for SAAB SF340 operations; the loaders had not loaded the aircraft as instructed; and furthermore some passengers, without the commander's knowledge, were not seated in their allocated seats.

The operator has subsequently made the following recommendations:

1. The aircraft commander should receive written confirmation that the hold has been loaded in accordance with his instructions.

2. The Cabin Services manual should be updated to state clearly that passengers may not be moved without the captain's permission.

3. When reporting to the aircraft commander before departure, the cabin crew should confirm the passenger distribution.

Conclusion

The likely cause of the incident was an extreme aft CG caused by incorrect loading of the baggage and the unauthorised relocation of some of the passengers.