

ACCIDENTS INVESTIGATION BRANCH
Department of Trade

**Avions Marcel Dassault Fan Jet Falcon LN-FOE
Report on the accident near Norwich Airport,
Norfolk on 12 December 1973**

List of Civil Aircraft Accident Reports issued by AIB in 1974

<i>No.</i>	<i>Short title</i>	<i>Date of publication</i>
1/74	McDonnell-Douglas DC8 – 63 CF N 801 WA and Aerospatial Caravelle 6 N 00-SRG approximately 10 nautical miles southeast of Lands End VOR, March 1973	April 1974
2/74	Piper PA 30 Twin Comanche G-AXRW at Shipdham Aerodrome, Norfolk, January 1973	April 1974
3/74	Slingsby T61A G-AYUO near Wycombe Air Park, Bucks., February 1973	May 1974
4/74	Viscount 802 G-AOHI at Ben More, Perthshire, Scotland, January 1973	May 1974
5/74	Owl Racer 65-2 G-AYMS at Greenwich Reach, River Thames, London, May 1971	May 1974
6/74	British Caledonian Airways BAC 1-11 at Corfu Airport, Greece, July 1972	May 1974
7/74	Wallis WA-117 Autogyro G-AXAR at Farnborough, Hants., September 1970	January 1975
8/74	AA-1 Yankee G-AYHD at Beverley Nursery, near Uxbridge, Middlesex, April 1973	July 1974
9/74	Cessna F172H G-AYDC near Humphrey Head, Lancashire, December 1972	June 1974
10/74	Beagle A.61 Series 2 (Terrier) G-ARZT near Tonbridge, Kent, August 1973	July 1974
11/74	Beagle A.61 Series 2 (Terrier) G-ATMS near Saltby, Leicestershire, August 1973	July 1974
12/74	Piper PA-30 (Twin Comanche) G-ASLD at Newchurch, Isle of Wight, May 1972	August 1974
13/74	Tiger Moth G-APVT and Rollason Beta G-ATLY at Nottingham Airport, September 1973	January 1975
14/74	Cessna F172H G-AVHI in the sea 44 nm east of Wick, Scotland, December 1973	October 1974
15/74	AESL Airtourer T6/24 G-AYMF near Lands End, Cornwall, June 1972	September 1974
16/74	Piper PA 28-140 G-AVBM near Dursley, Gloucestershire, August 1973	September 1974
17/74	Avions Pierre Robin DR 360, Robin Knight G-AZOX at Biggin Hill Aerodrome, Kent, July 1973	November 1974
18/74	Piper PA 23-250E Aztec G-AZIF near Great Sampford, Essex, January 1972	November 1974

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19/74	Chipmunk DH C1 Series 22A G-ARCR at Windlesham, Surrey, September 1973	November 1974
20/74	Jodel D117 G-ZFK at Doncaster Aerodrome, April 1973	December 1974
21/74	Societe Aeronautique Normande Jodel D117 G-AVEI at Brixham, Devon, September 1973	January 1975
22/74	Rollason Condor DB62B G-ATSK near Fairoaks Aerodrome, July 1973	February 1975
23/74	Piper PA 34 Seneca G-BBFF at Machrins airstrip Scotland, May 1974	<i>(forthcoming)</i>

Department of Trade
Accidents Investigation Branch
Shell Mex House
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17 December 1974

The Rt Honourable Peter Shore MP
Secretary of State for Trade

Sir

I have the honour to submit the report by Mr R D Westlake, an Inspector of Accidents, on the circumstances of the accident to Avions Marcel Dassault Fan Jet Falcon LN-FOE which occurred near Norwich Airport, Norfolk on 12 December 1973.

I have the honour to be
Sir
Your obedient Servant

W H Tench
Chief Inspector of Accidents

Accidents Investigation Branch
Civil Aircraft Accident Report No. 24/74
(EW/C473)

Aircraft: Avions Marcel Dassault Fan Jet Falcon LN-FOE
Engines: 2 General Electric CF 700-2C
Owner and Operator: Fred Olsen Airtransport Limited, Oslo, Norway
Commander: Captain H Mossin – Injured
Crew: Two – Injured
Passengers: Six – Uninjured
Place of Accident: near Norwich Airport, Norfolk
Date and Time: 12 December 1973 at 1538 hrs
All times in this report are GMT

Summary

The aircraft flew into a large flock of seagulls just after take-off, and sustained multiple bird strikes. Both engines failed due to bird ingestion and the aircraft made a forced landing in a field beyond the end of the runway.

The aircraft was substantially damaged and the three crew were injured; the six passengers were not hurt.

1. Investigation

1.1 History of the flight

The aircraft was on charter to fly passengers from Norwich to Gothenburg, Sweden, and during the morning of 12 December 1973 it made an uneventful positioning flight from Oslo, Norway, to Norwich where it landed at 1228 hrs. The six passengers boarded the aircraft at about 1520 hrs and the aircraft received clearance from Norwich Tower to taxi out for take-off on Runway 28. While taxiing the crew received an airways clearance and the aircraft was lined up on the runway without delay. The co-pilot, a qualified commander on this type of aircraft, was in the left hand pilot's seat, and the aircraft commander in the right hand seat. No bird flocks were seen by either of the pilots whilst taxiing to the active runway. The aircraft took-off at 1537 hrs piloted from the left hand seat; on becoming airborne, at a position a little over halfway down the runway, the crew saw a flock of birds ahead flying just above the ground. The pilot increased slightly the aircraft's climb attitude and the flock passed underneath. A few seconds later a second flock was seen at a higher level and directly in the aircraft's flight path. The pilot lowered the aircraft nose and the flock passed overhead. On re-establishing the climb and at a height of between 100 and 200 feet a third flock was seen, again directly ahead. This flock extended from ground level to well above the aircraft and there was no possible way for the pilot to avoid it; almost immediately the crew heard the sound of multiple bird strikes on the aircraft, the commander described the noise as 'like a machine gun'. The pilot maintained the aircraft in the climb attitude and the commander, who was checking the aircraft's instruments, noticed the RPM on both engines running down very fast, he also observed the engine pressure ratio (EPR), and exhaust gas temperature (EGT) instrument readings dropping. The pilot heard a bang from the engines, followed by the sound of the engines running down in a rough and abnormal manner. He quickly asked if both engines had failed. This was confirmed by the commander who tried to move the thrust levers without any response from the engines. By this time the aircraft was at a height of approximately 300 feet with the landing gear still down, the crew not having had time to select it up because of their preoccupation with avoiding the bird flocks.

The speed, which had been about 150 knots prior to the bird strikes, had dropped to 135 knots. The control column was eased forward to maintain speed and the aircraft began to lose height. The pilot saw a field ahead and slightly left of the aircraft which he considered the best forced landing area. On receiving confirmation of his decision from the commander, the pilot made a turn to the left and lined up the aircraft for an approach to the selected field. Visibility was not good because of approaching darkness but the crew were able to see some trees at the approach end of the field. These were avoided and a positive touch down made; the stall warning sounded just before the aircraft hit the ground. Battery and fuel switches were turned off either just before or after ground impact and an attempt was made to close the thrust levers, but these would not move. All three landing gear legs were torn off shortly after ground impact and the aircraft finally came to rest on the belly of the fuselage. The commander, although partially blinded by blood from cuts on his head, made his way to the main cabin door, which he opened, and all the occupants were evacuated.

1.2 Injuries to persons

<i>Injuries</i>	<i>Crew</i>	<i>Passengers</i>	<i>Others</i>
Fatal	—	—	—
Non-fatal	3	—	—
None	—	6	—

1.3 Damage to aircraft

The aircraft suffered substantial damage.

1.4 Other damage

Nil

1.5 Crew information

Commander: Captain Helge Mossin, aged 42

Licence: Airline Transport Pilot's Licence (Norwegian) valid to 3 June 1974

Aircraft rating: Fan Jet Falcon, single engine aircraft up to 5,700 kg, DC-6 co-pilot only

Last medical examination: 19 November 1973, valid to 3 June 1974

Last periodic flying test, (carried out twice yearly): 18 June 1973. This test includes an instrument rating check and flight emergency checks.

Total pilot hours: 5,939

Total flying hours on Fan Jet Falcon: 1,902

Total flying hours in last 30 days: 21

Rest period: the 5 days prior to the day of the accident.

Previous landings at Norwich: 1, on 25 April 1973

Captain Mossin was the operating company's chief pilot for the Fan Jet Falcon and flew regularly with the other Falcon captains in the company.

Co-pilot: Captain Bjorn Arnold Pedersen, aged 38

Licence: Airline Transport Pilot's Licence (Norwegian) valid to 6 March 1974

Aircraft rating: Fan Jet Falcon, single engine aircraft up to 5,700 kg, CV-340 co-pilot only

Last medical examination: 4 September 1973, valid to 6 March 1974

Last periodic flying test, (carried out twice yearly): 25 September 1973. This test includes an instrument rating check and flight emergency checks.

Total pilot hours: 5,814

Total flying hours on Fan Jet Falcon: 864

Total flying hours in last 30 days: 28

Rest period: the 3 days prior to the day of the accident.
Previous landings at Norwich: 1, on 25 April 1973

1.6 Aircraft information

The aircraft was constructed in France by Avions Marcel Dassault in 1967 and went into service with Fred Olsen Airtransport Limited on 9 January 1973. It had a valid Certificate of Airworthiness and had been maintained in accordance with an approved maintenance schedule. It had flown 14 hours since its last inspection (150 hour cycle) and 308 hours since a major overhaul; its total flying time was 4,779 hours.

Details of the two General Electric CF 700-2C engines are as follows:

	<i>Left</i>	<i>Right</i>
Date of manufacture:	1967	1965
Time since last overhaul:	1,324 hours	655 hours
Time since installation:	287 hours	64 hours
Time since last inspection:	14 hours	14 hours
Total time:	2,792 hours	3,594 hours

The certification basis of the CF 700 engine did not include either small or medium bird ingestion requirements as they were not applicable at the time of certification (July 1964).

Maximum take-off weight: 26,455 lb
Weight at take-off: 25,100 lb

The centre of gravity was within the 19% (forward) and 28.5% (aft) MAC limits. At departure from Norwich the aircraft's tanks contained 970 gallons of Jet A-1 (Avtur).

1.7 Meteorological information

The following weather observation was recorded at Norwich Airport at 1538 hrs:

Surface wind: 240⁰/15 to 25 knots
Cloud: 2/8 stratus at 1,500 feet
6/8 stratocumulus at 2,700 feet
Visibility: 7 kilometres
Weather: recent moderate rain
Temperature: +3⁰ centigrade

The natural light conditions at the time of the accident were twilight.

1.8 Aids to navigation

Not applicable.

1.9 Communications

The VHF radio communications between Norwich Tower and the aircraft were normal. The last message from the aircraft was an acknowledgement by the pilot for take-off clearance.

1.10 Aerodrome and ground facilities

Norwich Airport is situated 3 miles north of Norwich City centre and has an elevation of 117 feet. The airport surface area is some 600 acres which is grass covered apart from the two tarmac runways 10/28 and 04/22 which intersect near their midpoints. Runway 10/28 from which the aircraft departed to the west has a length of 1,842 m.

A total of about 35 dead, mutilated birds were found towards the end of Runway 28. It was not possible to determine the exact number as many of the birds had partially disintegrated. The birds were identified as Herring and Black Headed Gulls and the largest complete bird, a Herring Gull, had a 40 inch wingspan and weighed one pound.

1.11 Flight recorder

The aircraft was equipped with a SVIM 2122 (photographic) flight data recorder system, the recorder cassette of which was mounted in the radio rack immediately behind the left hand pilot's seat. The cassette was recovered undamaged; however, when it was opened, the roll of recording film was found to be jammed on the storage spool surround and was torn. Because of this damage, apparently due to incorrect loading of the film into the cassette, no recording of the accident flight had been made.

1.12 Wreckage

The aircraft made a forced landing in a ploughed field approximately one kilometre west-southwest of the end of Runway 28. It struck the ground on a heading of 240° (M) in a level attitude with the landing gear down and the flap and leading edge droop still in the take-off configuration – flap 15°, droop extended. On touchdown the mainwheels penetrated the soft ground and after running about six metres both main landing gear legs snapped off in rearward bending; the nose landing gear leg broke off shortly afterwards. The aircraft then slid in a straight line for approximately 135 m, during the course of which it ploughed through a large manure heap, positioned about 50 m from the touchdown point. This inflicted structural damage to the nose and left wing inboard leading edge, and caused the left engine to ingest a large quantity of manure. The aircraft came to rest flat on its belly and substantially structurally intact after having yawed to the right onto a heading of 307° (M) during the final 15 m of its ground slide.

The outboard section of the outboard (droop) leading edge was damaged on both wings and the inboard section of the trailing edges had been severely disrupted by the landing gear forcing them upwards and to the rear. Despite this damage the main wing box containing the integral fuel tanks was still intact and no fuel leakage occurred. The forward part of the fuselage had suffered a downward buckling failure just forward of the wing front spar; associated with this was considerable disruption of the under-floor structure of the forward part of the cabin.

The rear fuselage, tail unit and engine pods had sustained virtually no damage and despite the number of birds killed the aircraft showed evidence of only two firm bird strikes on the airframe and one glancing strike. Each engine showed evidence of having ingested at least one bird; the right engine had evidence of bird ingestion at both intake and fan exhaust; the left engine had suffered a massive ingestion of manure during the ground slide and showed no sign of bird ingestion at the intake, there were, however, feathers caught in the aft fan straightener vanes.

After the aircraft had been salvaged the engines were dismantled and examined, the result of the examination was as follows:

Left Engine: The primary damage appears to have been caused by a hard bird strike on the fan, which is situated at the rear of the engine. The fan and its turbine are mounted on a single disc, the long blades act as turbine blades on their inner part and as fan blades on the outer part. Eleven complete fan blades were broken off and eight others were partially broken off and bent. Some of the broken fan blades penetrated the shroud casing and other parts had driven forward and were ingested into the core engine. The damage caused by these fragments to the compressor was sufficient to make it stall and thus cause the whole engine to run down.

Right Engine: Positive evidence of bird ingestion was visible in the intake of this engine. A group of three first stage rotor blades and ten blades of the second stage had been 'feathered'. The forward bending and feathering of the second stage blades had caused the blade tips to foul the trailing edges of the second stage stator vanes and bend them in the direction of rotation. Two blades on the fourth stage rotor and two on the fifth stage rotor had suffered similar damage with the associated stator vane damage. There was also evidence of bird remains all through the compressor and in the bleed air ducting.

The effect of the damage to the compressor would be to reduce drastically the efficiency of the airflow through the compressor. This would have led to repeated compressor stalls and/or surging of the core engine with a subsequent loss of power.

1.13 Medical and pathological information

The three crew members suffered cuts, abrasions and bruising, generally to the forehead and face. After hospital treatment the commander was discharged after 4 days and the co-pilot and stewardess after 6 days. Some of the passengers suffered minor bruising.

1.14 Fire

No fire occurred.

1.15 Survival Aspects

Soon after the aircraft took off the duty controller in Norwich Tower noticed an orange flash from its left engine when the aircraft was about 200 feet on the climb out. He then observed the aircraft turning left and descending and attempted to establish VHF radio contact with the pilot but without success. As the controller felt certain that the aircraft was about to forced land he alerted the outside emergency services and placed the Airport Fire Service on standby until the location of the aircraft's position could be determined.

The pilot of a helicopter that was about to land at the airport saw the aircraft forced land. He contacted Norwich Tower by radio, flew to the site of the accident and passed information on the position and condition of the crashed aircraft. He then landed beside

the wreckage just as the crew and passengers were leaving the fuselage. After checking on the conditions of the occupants he relayed the information to Norwich Tower.

Quite fortuitously an ambulance was passing the airport and when the driver saw the aircraft forced land he drove to the accident site where he gave assistance to the injured and then took some of them to hospital. When the location of the accident was reported by the helicopter pilot the Airport Fire Service was dispatched to the scene and by 1600 hrs all rescue services, fire, police and ambulances were at the accident site.

All six passengers, five of whom were in forward facing seats and one in an aft facing seat had their seat lapstraps fastened. The pilots' seats were equipped with lapstraps and with shoulder harnesses which however were of the fixed (non inertial reel) type and which, according to the commander, made it almost impossible to operate certain of the aircraft's radio and navigational aids when fully tightened. The pilots were therefore only using the lapstraps and jackknifed and suffered head injuries during the accident. The stewardess was seated in her normal place on the jump seat between the pilots and when she realised that the aircraft was about to forced land she left her seat to go back to her passengers. At that moment the aircraft hit the ground and she was thrown forward in the cockpit and injured.

1.16 Tests and research

Nil

1.17 Other information

East Anglia has an abundant bird population of gulls and lapwings and at Norwich Airport it had been observed that the gulls had recognised loafing areas; these were on the apron and grass areas adjacent to the control tower and the threshold of Runway 04. As a bird control measure the grass on these areas was allowed to grow long. However, at the time of the accident, the sward was limp and laid flat which probably reduced its effectiveness. When ATC personnel in the tower saw bird flocks in a dangerous position on the airport with regard to aircraft movements a landrover and crew were sent out and attempts made to disperse them by driving the landrover along the runway in the area where the birds were congregating. Although this method of bird dispersal had some success the bird action co-ordinator at the airport considered that it was largely ineffective and had advised the airport management that bird distress call broadcasting equipment (Sappho) and/or shell-crackers were necessary if the bird hazard was to be overcome. However, because of shortage of funds and manpower the airport manager felt unable to recommend the purchase of this equipment to the Airport Joint Committee.

At the time of the accident ATC personnel in the tower had carried out their regular practice of looking for bird flocks prior to an aircraft taking off; no bird flocks were observed in the vicinity of or on any part of the airport. However, a slight dip in the ground in the area of the active runway, where a substantial number of dead birds were found, effectively placed this part of the runway out of sight of the tower. Also, at the material time, visibility from the tower was affected by approaching darkness and by condensation inside the windows and by rain droplets on the outside. Although a flock of gulls may have settled on or near the runway, the bird action co-ordinator believed it far more probable that the birds struck by LN-FOE were part of an incoming flock preparing to land on the runway. In support of this contention other large bird flocks were seen arriving from the northwest subsequent to the accident.

2. Analysis and Conclusions

2.1 Analysis

It is evident from the circumstances of this accident that the aircraft suffered multiple bird strikes shortly after it became airborne and that the two engines failed because of internal damage after each had ingested one or more of the birds. From the evidence of the crew and examination of the wreckage it is apparent that the aircraft, its controls and all other services were operating satisfactorily during the short time of the flight. Only the engines are therefore considered as being relevant to the accident. It is noteworthy that bearing in mind the low height at which the bird strike occurred and the short time available following the double engine failure for the crew to decide on their course of action, they displayed a high degree of professional airmanship in forced landing a modern jet feeder aircraft without serious injuries to their passengers, albeit they suffered some degree of injury themselves. Although there was sufficient time for the pilots to have retracted the landing gear before touchdown they apparently elected to leave it extended. It would appear that on this occasion the consequences were beneficial since the energy absorbed during the rearward breakage of the landing gear may well have served to minimise damage to the fuselage and to the passengers.

The hazard of bird strikes at aerodromes is a continuing one and a number of measures have been developed against it. At Norwich, when bird flocks were seen from the tower, the method employed was to dispatch a crew on a landrover to the appropriate area on the airport and attempt to disperse the birds by driving up and down the active runway. Although this method apparently had some success in the past, in the opinion of the bird action co-ordinator at Norwich this form of bird scaring service was not effective. He felt that bird distress call broadcasting equipment (Sappho) would have been an advantage. However, although this Sappho method of bird scaring is considered more efficient, it would appear unlikely that even if it had been available it would have been used before the take-off of LN-FOE since at that time the tower personnel were not aware of any flocks of birds on the airport. It is not possible to decide why the birds were not seen from the tower. They may have been on that part of the runway which was out of sight of the tower or they may have been part of a flock arriving over the airport as LN-FOE was taking off. Further factors limiting the ability of the tower personnel to see the bird flocks may have been the failing light and the obscuration of the tower windows by inside condensation and by exterior water droplets from recent rain.

It is a matter for consideration whether airfields such as Norwich, within a short distance of the coast, or any other airfields with a persistent bird problem, should instigate a runway inspection for birds before each take-off and landing. On the other hand advice from the Pest Infestation Control Laboratory of the Ministry of Agriculture, Fisheries and Food was that disturbing the birds immediately prior to an aircraft movement and then allowing them to remain on the airfield for long periods until another aircraft movement was not the best approach; persistent dispersal during slack periods was considered preferable. Whatever system is used, practical considerations must necessarily relate it to the availability of personnel and to cost and it is also highly improbable that any aerodrome can be kept entirely free of birds whatever system is employed. Nevertheless, the costs of any system or improvement of an existing system would be relatively minor when compared with the risk to life of the occupants and the costs of the repair or replacement of a modern transport aircraft. Since the accident Norwich Airport have put in hand the purchase of shell-crackers and have constructed a system similar to Sappho which is in experimental use in co-operation with the Ministry of Agriculture, Fisheries and Food. They are also examining the problem of rebuilding the visual control room of the tower at a greater height to incorporate double glazing, inward sloping windows and tinted glass.

The other facet of this accident from which useful information of general application may be drawn relates to the crew injuries. There can be no doubt that if full use had been made of the pilots' shoulder harnesses their facial injuries would have been reduced if not eliminated. However, the harnesses were not worn because, according to the commander, they restricted the pilots freedom to operate essential items of equipment. The injuries sustained by the pilots during this accident emphasise the necessity for equipping their seats with inertial reel type shoulder harnesses which do not restrict normal movement in the cockpit. Although the stewardess was undoubtedly highly motivated by her concern for her passengers her action in leaving her seat to go back into the cabin before the aircraft had come to rest must be seen as a misplaced sense of duty and could well have led to far more serious injuries than those she actually sustained.

2.2 Conclusions

(a) Findings

- (i) The aircraft had been properly maintained and its documentation was in order.
- (ii) The crew were properly licensed and adequately experienced for the flight.
- (iii) Prior to take-off no concentration of birds was seen on the airport by the aircraft crew or by ATC personnel in the tower.
- (iv) A large concentration of seagulls was either on the active runway or was arriving over the airport at the time of take-off.
- (v) The aircraft suffered multiple bird strikes immediately after take-off and both engines failed due to bird ingestion.
- (vi) The crew made a successful forced landing in a field near the end of the runway and are to be commended for the high degree of professional airman-ship displayed.
- (vii) During the forced landing the aircraft was substantially damaged but the passengers did not suffer any appreciable injuries; the three crew members suffered varying degrees of injury.

(b) Cause

The accident was caused by failure of both engines because of mechanical damage due to bird ingestion.

3. Recommendations

It is recommended that:

- (1) Aerodrome operators should review their bird control organisation and methods of bird dispersal in the light of the circumstances of this accident.
- (2) The problem of interior condensation and/or external water droplet obscuration of aerodrome control tower windows should be examined and the necessary corrective action taken.

R D Westlake
Inspector of Accidents

Accidents Investigation Branch
Department of Trade

December 1974