Fokker F27 Mark 500, G-CEXA, 6 May 1997

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Aircraft Type and Registration:	Fokker F27 Mark 500, G-CEXA
No & Type of Engines:	2 Rolls Royce Dart 532-7 turboprop engines
Year of Manufacture:	1974
Date & Time (UTC):	6 May 1997 at 0711 hrs
Location:	Runway 27, Jersey Airport
Type of Flight:	Public Transport (Freight)
Persons on Board:	Crew - 2 - Passengers - None
Injuries:	Crew - None - Passengers - N/A
Nature of Damage:	Substantial to nose landing gear, fuselage, both engines and propellers
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	63 years
Commander's Flying Experience:	15,486 hours (of which 5,168 were on type)
	Last 90 days - 71 hours
	Last 28 days - 17 hours
First officer's Age:	24 years
First officer's Flying Experience:	502 hours (of which 10 hours were on type)
	Last 90 days - 10 hours
	Last 28 days - 10 hours

Synopsis

The aircraft was operating on a scheduled freight service carryingnewspapers from Bournemouth to Jersey. The commander, a trainingcaptain working part time for the company, was training a newfirst officer on his first line-training sector. The flight,which was delayed due to poor weather and strong cross winds atJersey, departed nearly three hours behind schedule at 0638 hrswith the first officer as the handling pilot. He flew for mostof the sector but the commander briefed that he would probablytake control for the landing. The aircraft was radar vectoredfor an ILS approach to Runway 27 at Jersey where the weatherhad moderated to give a surface wind of 330°/24 to 34 ktwith a visibility of 30 km and a cloud base of 1,600 feet. Thefirst officer continued to fly the aircraft as it descended onthe glide path with the commander taking control 4 seconds beforetouchdown. The aircraft landed heavily nosewheel first distortingthe nosewheel assembly rearwards into the aircraft structure. The aircraft bounced, and after a second heavy impact, the mainlanding gear retracted allowing the fuselage to contact the runway. The aircraft slid several hundred metres along the runway beforedeparting the paved surface coming to rest on the grass closeto the airfield boundary. There was no fire and the crew vacatedthe aircraft without injury.

History of the flight

The first officer, who was relatively inexperienced and new totype, had just completed his initial line check. He had reachedan acceptable standard and was considered ready for line training. He had been given extra base training because of an initial inabilityto appreciate flight path deviations and descent rates duringthe final approach and landing phase.

His first line training flight was rostered to be the early morningflight from Bournemouth to Jersey departing at 0345 hrs. He reporteda little earlier than required in order to acquaint himself withthe paperwork and produce an initial load sheet for the flight.

The commander, who worked for the operator on a part-time basis,reported for duty at 0245 hrs. Having checked that the firstofficer was in possession of all the necessary paperwork he checkedthe Jersey weather to find that it was raining and that the windwas at 90° to Runway 09/27 and outside the F27 crosswindlimits of 29 kt on a dry runway and 15 kt when wet. The flightwas therefore delayed pending an improvement in the conditions.

By 0620 hrs the rain had ceased and the wind had abated slightlyto 340°/25 to 37 kt thus favouring Runway 27. The aircraftdeparted 'off chocks' at 0634 hrs and was airborne at 0644 hrs. On the suggestion of the commander the first officer was thehandling pilot. The commander had briefed that there was a strongpossibility that he would take control for the landing as thewind was close to the crosswind limits.

The aircraft departed from Bournemouth androuted direct to the reporting point ORTAC. After establishing in the cruise at FL 100 the crew wereadvised by ATC that they would be making an ILS approach to Runway27 at Jersey. The commander set up the navigation aids for theroute, briefed the first officer about the landing, and statedthat he would let the first officer fly the aircraft until he,the commander, felt that the crosswind was becoming a problem. At this stage the first officer set his speed bug to 95 ktfor the landing. When the first officer requested the descentchecks the commander actioned them but did not employ the usualchallenge and response technique.

At 0700 hrs the aircraft was cleared to 6,000feet and was in the descent when the commander carried out theapproach checks. These again were actioned individually by thecommander alone. After clearance was obtained to descend to 3,000feet the commander set up both ADFs and the ILS receiver on hisside for the final approach and landing. He also requested thesurface wind at Jersey which was given by ATC as 330°to 340°and 20 kt to 26 kt.

The Jersey approach controller vectored theaircraft initially onto a heading of 170°M. The commander noticed that the first officer had turned onto160°Mand restated the correct heading which the first officer thenfollowed. The commander also set up the first officer's ILS receiverfor the landing. The controller then instructed the crew to descendto 1500 feet on the QNH of 994 mb and turn right onto 245°Mto intercept the localiser. Three minutes before landing theaircraft crossed the runway extended centreline on a heading of220°M still in the turn onto 245°M. The commander advisedthe approach controller that the aircraft had flown through thelocaliser and was continuing the turn onto 300°. ATC suggesteda heading of "315°OWN NAVIGATION REPORT ESTABLISHED". The commander selected the first stage of flap just prior tolocaliser capture and was instructed by the approach controllerto call Jersey tower. One and a half minutes before landing theaircraft began the final descent and made a left turn onto therunway heading. The first officer called for the landing checkswhich the commander performed on his own, the only comments fromthe first officer being 'six greens' confirming that the landinggear was down and locked.

At 0710 hrs the tower controller transmitted"...CLEAR TO LAND RUNWAY27 SURFACE WIND 330 DEGREES 27 KNOTS". The commander acknowledged the clearance and shortly after thisexchange the aircraft's Ground Proximity Warning System (GPWS)'GLIDE SLOPE'alert sounded. The commander then said "OH,IGNORE THAT FOR A MINUTE...JUST COCK YOUR NOSE UP A BIT TO STOPTHE ROW...BECAUSE YOU'VE GOT THREE REDS"(indications from the runway Precision Approach Slope Indicators(PAPIs)). In total, six 'GLIDESLOPE' warnings sounded before thewarning ceased 30 seconds before touchdown.

Forty seconds before touchdown the commander,without prompting from the first officer, selected full flap (40°)whilst the first officer maintained an airspeed of 106 kt to 111kt with an average descent rate of 650 ft/min. Five seconds beforethe landing the commander stated that he was taking control. This was acknowledged by the first officer. For the next threeand a half seconds the rate of descent reduced and airspeed decayedto between 97 kt to 104 kt. In the final one and a half secondsbefore touchdown both airspeed and rate of descent increased. The aircraft struck the runway at a speed of 106.8 kt and a normalacceleration of +3.7g was recorded on the Digital Flight DataRecorder (DFDR). During this impact the Cockpit Voice Recorder(CVR) recorded the intermittent sound of the gear unsafe warninghorn. The aircraft became airborne again for 2.6 seconds andairspeed decayed to 95 kt before it landed on the runwayfor a second time and registered a normal acceleration of +3.0g. At the second impact the gear unsafe warning horn was again activatedand became continuous.

For the next 15 seconds the aircraft slidalong the runway with the lower surface of the fuselage in contactwith the paved surface. Sounds of a propeller striking the groundwere recorded on the CVR. Another large vertical accelerationpeak was recorded on the DFDR coincident with an increased audiolevel on the CVR as the aircraft departed the runway and slidfor a further five seconds. It eventually came to rest on thegrass area mid-field between the runway and the boundary fence. The commander and first officer vacated the aircraft uninjured. Fire service personnel who were on 'weather standby', witnessedthe landing and were in attendance within thirty seconds. Theairfield which was closed after the accident was reopened 5:45hours later at 1256 hrs.

The pilot of a Trislander aircraft, who landedon Runway 27 some 16 minutes before the F27, stated that for hisapproach there had been only light turbulence with no appreciablefluctuations in airspeed. Furthermore the DFDR from the F27 gaveno evidence of variations in the recorded airspeed during thelanding.

Eye witnesses

Many people witnessed the later stages ofthe approach and the landing. One eye witness, a policeman situatedin police accommodation overlooking the runway, stated that hecould clearly see the landing gear was down before touchdown. He reported that 'at a point where he would have expected thenose of the aircraft to rise he saw it maintain it's nose downattitude and moreover appeared to become steeper in attitude toa point where it would make a nose wheel first landing'. A secondpoliceman stated that 'the nosewheel hit runway, he heard a bang,the aircraft settled onto its main wheels and then bounced some10 to 15 feet in height before settling onto the runway nosewheelfirst'.

A fireman positioned in the Fire Station reportedthat 'the aircraft's descent seemed to become abnormally steepbefore it impacted heavily nosewheel first, bouncing back ontothe main landing gear then onto the nose gear again. As the nosewheellifted for a second time he heard a bang and saw the nosewheelflapping from side to side.'

Weather

The UK low level forecast issued by the MeteorologicalOffice at 2130 hrs on 5 May 1997 and valid between 0000 hrs and0600 hrs on 6 May 1997 showed an occluded front lying from theCherbourg peninsular to the Hook of Holland moving south-eastat 20 kt. This was giving rise to a visibility of generally 12km in nil weather with an occasional reduction to 7 km in rainand isolated thunderstorms and heavy rain with a reduction invisibility to 3,000 metres near the front. It also forecast cloudon the hills, moderate icing and moderate turbulence in cloudand moderate with isolated severe turbulence below 6,000 feetnorth of the front. In the area behind the front the forecastshowed an improvement to 20 km visibility reducing to 8 km inisolated rain showers and 3,000 meters in isolated thunderstorms. The outlook to 1200 hrs was for showers developing more widelyover land, otherwise little change.

This forecast corresponded to the actual conditionsrecorded at Jersey during the early hours of the morning of theaccident. The 0520 hrs observation gave a visibility of 6 kmin rain with broken cloud at 700 feet and broken cloud at 1,100feet with a surface wind of 350°/26 to 40 kt. At the timeof the accident the weather had moderated to a visibility of 30km, nil weather, few clouds at 800 feet, broken cloud at 1,600feet and a surface wind of 330°/24 to 34 kt.

Crew Resource Management (CRM)

The first officer reported for duty earlierthan required on the morning of the accident in order to familiarisehimself with the pre-flight preparation. One of his duties wasto produce an aircraft load sheet reflecting the expected loadof 4,500 kg of newspapers. The commander arrived at 0245 hrs,one hour before the scheduled time of departure, and checked thefirst officer's preparation and the weather conditions. At approximately0305 hrs both the commander and first officer left Operationsto go to the aircraft. This was a little earlier than normalin order to give the first officer sufficient time to completethe internal aircraft pre-flight checks. With the checks completethe commander re-checked the Jersey weather and, discovering thatthe wind was still outside the cross-wind limits, returned withthe first officer to operations to await an improvement.

It could not be determined exactly what theactivities of the two crew members were during the delay. Thecommander did not however have much contact with the first officer. He did not discuss in any detail the forthcoming sector, whichwas to be the first officer's first line training flight, nordid he check the calculations and presentation of the load sheetthat had been prepared earlier. The load sheet was in fact completedin error with some fundamental mistakes being made on the calculationof the aircraft's centre of gravity. The commander had signedthe load sheet as being correct anyway.

The CVR recording provided an insight intohow the flight was conducted. It was the operator's common practicefor a new first officers undergoing training to operate as thenon-handling pilot for at least the first two sectors in orderfor them to settle into normal first officer duties. Only afterthis settling in period do they act as the handling pilot. Thecommander had decided that on this occasion that the first officerwould handle the aircraft.

The commander was an experienced F27 pilotwho had flown the sector to Jersey on many occasions. The proceduresto him appeared routine to the point of being mundane. The firstofficer was new to type, inexperienced yet keen to please andperform well. The cross-cockpit gradient was therefore extremelysteep.

Evidence from the CVR indicates that the commanderdid not allow the first officer, as the handling pilot, to truly'operate' the aircraft. He did not coax the first officer bysuggesting, in advance, the methods for good flight deck and timemanagement. He pre-empted all the decision making and actionedall the checklist items unprompted and in isolation. Insteadof allowing the first officer to brief for the approach the commanderrushed through his own brief, paying scant regard to the firstofficer's understanding. On several occasions the first officertried to enter into normal conversation with the commander. Hisattempts at this however were met with uncharacteristic dismissal.

The commander had carried out CAA approvedCRM training in November 1993 and a refresher in June 1996. Thefirst officer was to settle into the position before undergoingCRM training.

The commander's schedule

The commander's activities on the seven dayspreceding the accident were examined in detail. On Tuesday 29May 1997 he had operated a flight from Coventry going off dutyat 0400 hrs the next morning. The remainder of that day and thenext three days were free from duty.

At 1200 hrs on Sunday 4 May he travelled bycar from his home in Coventry to Bournemouth in order to positionfor a forthcoming flight on the Monday. He spent Sunday afternoonwith friends near Bournemouth before 'checking in' at a localhotel. He arrived at the hotel at 2100 hrs and was asleep by2245 hrs. On Monday 5 May 1997 he awoke at 0200 hrs to operatethe 0345 hrs flight from Bournemouth to Jersey and return. Hereported 'on duty' at 0245 hrs and went off duty after the flightsat 1205 hrs. That afternoon he met with friends to play squashand enjoy an evening supper. At 1800 hrs he took two extra strongnon-prescription pain killers to combat toothache. He returnedto his hotel at 2015 hrs and took a further two extra strong painkillers. He went to bed at 2045 hrs but did not sleep until 2330hrs due to aggravation from the sore tooth. At 0215 hrs on theday of the accident he awoke to report for duty by 0245 hrs.

Crew records

The commander joined the operator in April1994 having flown the F27 with a previous operator, holding thepositions of Base Manager and line pilot. The Flight OperationsManager of his new operator was satisfied that the training givenby the previous operator was acceptable and a certificate to thateffect was signed in April 1994. The Operations Manual includedthe commander's name as an authorised Line Training Captain (F27). The commander terminated his employment with the operator witheffect from 31 January 1997 but agreed to work, freelance on apart-time basis, flying on Mondays and Tuesdays only. The OperationsManual did not reflect his freelance status at the time of theaccident.

Training

The entry in the Operations Manual, Section3 paragraph 6 titled 'Line Training' states that:

'The purpose of Line Training is twofold. Firstly it will enablethe new converted pilot to settle down to his duties on the newtype, in the company of an experienced and qualified pilot speciallydesignated for the purpose and to turn to him for advice if necessary. Secondly, it will enable the training staff to assess and verifythe adequacy of the conversion training and to ensure that properoperating standards are achieved at the outset, in the courseof normal and varied operations.'

It also states that:

Co-pilots should have 'a minimum of 20 sectors/30 hours undersupervision of a Line Training Captain. At least 8 sectors shouldbe flown by the Co-pilot as P1 under supervision. A coveringCo-pilot will be carried until released by the Line Training Captain.'

The commander stated that he had not found out about the FirstOfficer's early difficulties in appreciating flight path deviationsand descent rates during the approach and landing. He had notsought the First Officer's training records prior to the flight. Although a covering co-pilot had been rostered for the flight,he had been re-tasked to fly on an air test.

Glide slope warning

The F27 Non-Normal Check list includes anentry titled 'GLIDE SLOPE WARNING'. The associated procedure states: 'Adjust flight path to regain Glide slope. Note: In certain circumstancesthe warning provided by the GPWS may be very late, so recoveryaction should be both prompt and positive'.

The Operations Manual (Section 16.1.1) statesin the section 'FOKKER F27 TRAININGPROCEDURES' - GROUND PROXIMITY WARNING SYSTEM',that 'Activation of Mode 5 - Excessive deviation below the ILSglide slope - requires immediate action to regain the glide slopeor a go-around initiated.' Evidence from the CVR showed thatthe reaction of the commander to the glide slope warning duringthe later stages of the approach appeared to be casual and lessthan helpful to his trainee.

Operations conclusions

In summary, although the commander had beenrostered for the required periods of rest before the accidenthe had in fact slept for only had 8 hours, due in part to a toothache,in the 48 hours preceding the accident. It could not be determinedwhether the non-prescription pain killers had any detrimentaleffect on his performance. Nevertheless these factors probablycombined to degrade his performance and reaction times on theday of the accident.

Engineering investigation

Ground marks

The first set of ground marks were on therunway centreline, some 200 metres from the Runway 27 thresholdand corresponded to the impact of the aircraft's nosewheel. Thesecond set were close to the centreline, some 125 metres furtheralong the runway. These marks matched the damage to the aircraft'snose landing gear leg. From a point 90 metres further along therunway the marks became continuous, showing that the fuselagewas now in contact with the runway. At this point evidence showedthat the right-hand propeller was cutting into the runway surface. Further runway marks showed that, as the aircraft continued,it veered to the right side of the runway and slithered onto thelevel grass surface. The aircraft came to rest about 90 metresfrom the edge of the runway, slewed through some 80°. Betweenthe first set of impact marks and coming to rest the aircrafthad travelled approximately 690 metres.

Structural damage

The aircraft had been severely damaged bothby its two impacts with the ground and the subsequent slide alongthe runway and over the grass. Furthermore the vertical speedat impact had significantly exceeded the levels required to bedemonstrated for type certification.

The damage to the propellers matched the groundmarks, showing the propeller blades to be in fine pitch duringthe ground slide, and the damage to the skins and frames of thelower fuselage matched the marks on the runway and grass.

The nose area was extensively disrupted inthe two impacts with structural damage extending through the forwardpressure bulkhead up to the flight deck. The tyre on the nosewheelhad burst showing 'overload' characteristics typical of a highenergy arrival and the lugs carrying the lower end of the noseleg damper had also failed under the high vertical loads on thenosewheel. The nose leg had then folded rearwards with its airframeattachments, fracturing the lower attachment of the retractionram. This ram had subsequently retracted along with the mainlanding gear legs, leaving the nose leg with its down lock engaged.

Landing gear system examination

After the accident it was found that bothmain landing gear legs were undamaged and had retracted and werefully engaged in their 'up locks'. During the recovery operation,with the airframe partly supported by a crane, the landing gearcontrol handle could not be moved from the intermediate positionin which it was found and so the main landing gear legs were loweredusing the Emergency landing gear control handle. The legs loweredeasily and were locked down.

The three Fokker F-27 landing gear legs areretracted and extended pneumatically, using a 1,000 psi pneumaticsupply and this same supply powers the up locks. Pressure tothe pneumatic rams is controlled by a selector valve, moved bythe landing gear control handle by a through a simple 'Teleflex'cable, routed under the cockpit floor. The landing gear controlhandle is mounted behind the instrument panel and is preventedfrom moving upwards, when the aircraft is on the ground, by asolenoid which moves a locking pawl. This locking pawl physicallyblocks any UP movement of the landing gear control handle whilethe solenoid is in its 'relaxed' position; only when the solenoidis energised by movement of the ground-flight switch (on the left-handmain landing gear leg) may the landing gear control handle bemoved upwards. There is no actual 'detent' at either the UP orDOWN positions but a small spring-and-slider assembly, attachedto the handle, acts in an 'over-centre' manner to retain the handlein its selected position.

The landing gear control system was examinedin detail. The system was intact, appeared correctly rigged andthe handle itself was seized in a position approximately 75% tothe fully UP position. This handle position corresponded to theposition of the input lever on the pneumatic selector valve. The Teleflex cable between the two units was still intact, withthe outer sheath complete. The disruption of the lower fuselagehad introduced extra bends into the cable and one of these bends,where the cable passed through a horizontal member at the levelof the flight deck floor, was of sufficiently small radius tojam the cable core.

The landing gear warning system activatesa warning horn on the flight deck if any of the landing gear legsare not fully locked down and either the flaps are extended beyond25° or at least one of the throttle levers is at a positioncorresponding to less that 10,500 RPM. With the flaps still attheir fully extended (40°) position electrical power wasapplied and the warning system tested. The horn sounded correctlyboth with closure of the test switch and either of the main landinggear down lock switches.

Engineering conclusions

The process by which the landing gear wasable to retract during the landing sequence was examined in detail. The flight crew stated that they did not move, and had no reasonto move, the landing gear lever after they had confirmed "sixgreens" on the final approach.

As all three gear retraction rams had actedtogether they must have been in receipt of a common signal fromthe selector valve. This was confirmed by the position of theselector valve input lever which corresponded to the positionof the landing gear handle on the flight deck. During the structuralrepair of the aircraft, it was confirmed that the Teleflex cablelinking the landing gear handle and the landing gear selectorvalve was intact but had become jammed due to airframe distortionjust below the level of the flight deck floor. There was no distortionor damage in the area of the selector valve and the UP signalwas, therefore, as a result of movement of the landing gear handle,before the Teleflex cable was distorted and jammed.

The CVR showed that the steady tone of thelanding gear warning horn commenced 0.5 seconds after the secondimpact. Tests on two different F27 aircraft showed that, withflaps deployed or throttles at idle, the horn would generallysound some 0.5 seconds after a sharp movement of the landing gearhandle to the 'UP' position. The sounding of the landing gearwarning horn would therefore have been consistent with movementof the handle in the second impact.

It is therefore possible that the landinggear handle had rotated upwards within its bracket during thesecond impact, by contact with the bottom of its slot within theinstrument panel. There was evidence that the instrument panel,which is mounted on anti-vibration mountings, had moved upwardsby some 10 mm at some point during the impact and it is possiblethat this movement, combined with deflection of the bracket fromdeformation of the forward pressure bulkhead, had moved the handleupwards against the damping friction of the Teleflex cable andthe 'over-centre' spring.

Duplicate main landing gear indicators(green lights)

The normal method of determining whether thelanding is down and locked, in the event of a landing gear malfunction,is visual inspection of the main landing gear legs from withinthe cabin. Access to the cabin windows for a visual inspection,however, is sometimes not possible due to bulk loads carried withinthe compartment. The crew are therefore provided with an independentmeans of ensuring that the legs were down and locked in the formof a second set of green 'down and locked' lights positioned onthe flight deck.

It was noted during the investigation thatthe second indicating system was not truly independent as bothsystems were actuated by the same set of micro switches. However,a review of FAR Part 25, BCAR Section D and JAR 25 indicates thatthe provision of an independent indication system, provided inmost large aeroplanes, is not a part of these airworthiness codes.

Flight Recorders

Digital Flight Data Recorder (DFDR)

The aircraft was fitted with a DFDR whichrecorded, amongst other parameters, the aircraft's height, magneticheading, IAS, flap position and normal acceleration. Pertinentdata from these parameters is included in the history of flightsection above.

DFDR installation

The DFDR was of a type that had built-in transducersfor airspeed and barometric altitude. To use these transducersthe DFDR would have been pneumatically coupled to the pitot/staticsystem of the aircraft. The position of these two parametersin the recorded data stream and the algorithms required to convertthe raw data back to engineering units are well documented inthe DFDR Maintenance Manual. However, this aircraft had beenfitted with two separate transducers as part of a draft modificationintroduced by the organisation that was responsible for the maintenanceof the flight data recording system. As the new transducers wereof a different type and were electrically connected to the DFDR,the airspeed and altitude values from them had different conversionalgorithms and were recorded in different positions in the DFDRdata stream. Part of the introduction of the draft modificationrequired the amendment of the Aircraft Maintenance Manual (AMM)to reflect the changes in data stream position and parameter conversion. At the time of the accident the AMM had been amended to reflectthe new data positions but the conversions, in the form of acceptabledata ranges, were incorrect for the transducers fitted.

The draft modification was embodied on theaccident aircraft early in 1996. The installation was requiredto be checked functionally and calibrated to the requirementsof the amended AMM and the DFDR was to be removed for a mandatoryreadout by a separate company. Both of these requirements werestamped as having been completed by the maintenance personnelresponsible. The readout company performed the DFDR replay inApril 1996 but treated the DFDR as one which was connected pneumatically,not electrically. The altitude and airspeed recorded parametervalues were thus taken from the DFDR internal transducers which,although functioning, were not connected to the aircraft's pitot/staticsystem. The company then alerted the maintenance organisationto the fact that airspeed was not being recorded correctly inthat no variation of the replayed trace from zero knots was observed. Variation in barometric altitude was seen but, because the DFDRwas mounted in a pressurised part of the aircraft, this parameterwas effectively recording the cabin altitude and not the altitudeof the aircraft.

Upon receipt of the notification, the maintenanceorganisation discovered an error in the draft modification wiringdiagram for the new transducers. This error was interpreted tobe the reason that the airspeed parameter was inoperative. Theerror was corrected and the modification raised to issue 1. Theembodiment of the modification on the aircraft was raised in line.

No further relevant work was conducted onthe DFDR installation until December 1996 when the next mandatoryDFDR readout and calibration was scheduled. The calibration ofthe DFDR installation was conducted against the amended AMM containingthe wrong airspeed and altitude conversion ranges and the worksheetwas stamped as complete by maintenance personnel.

The FDR readout was conducted by the sameorganisation that carried out the previous one. Although therewas no evidence found at either the maintenance or readout organisationsto advise that the DFDR airspeed and altitude transducers wereelectrically connected, the DFDR was read out using the correctdata stream parameter positions and no anomalies were observed. The readout consisted of traces of a flight with all parametersplotted in raw data units. It was, therefore, impossible to assessvisually whether the data would have fallen with the limits of'reasonableness', ie low airspeed when on the ground etc. A snapshotof data during the cruise phase of the flight was converted toengineering units, but, without knowledge of the flight detailssuch as cruise airspeed, altitude and heading, no degree of certaintythat the correct conversion algorithms were used could have beeninferred.

In an attempt to establish the algorithmsrequired to convert the airspeed and altitude raw DFDR data toengineering units, AAIB requested a calibration check of airspeedand altitude recording on the accident aircraft. This was carriedout and a successful conversion for airspeed was derived. However,the calibration of the recording of altitude showed erroneousvalues due to damage sustained during the accident. A calibrationof altitude was successfully performed on an identical, undamagedaircraft, when it became available, which provided a generic conversionalgorithm for the type but was not specific to the accident aircraft. A final calibration of the accident aircraft was not possibleuntil significant repair action had been implemented. This causeda delay of many weeks before absolute validation of the data recordedby the DFDR during the accident was possible. Since the accidentthe maintenance organisation has corrected the errors in the calibrationranges of the airspeed and altitude set out in the AMM and hasincluded provision for recording parameter values observed duringthe calibration of the DFDR installation.

Cockpit Voice Recorder (CVR)

The aircraft was fitted with a 30 minute continuous loop tapeCVR. As the commander gave his landing briefing there was evidenceof loud audio interference on the two crew channels for a periodof five seconds. The level of the interference was slightly higherthan that of the audio level of crew conversation and renderedthe crew speech partially unintelligible. The interference occurredon two further occasions on the CVR recording but only on thecommander's audio channel and when he was not speaking. Neithercrew member was aware of the interference being caused. The creware provided with a company mobile telephone which is stored onthe flightdeck. This phone, however, was switched off and thesource of the interference was subsequently confirmed to be fromthe commander's own personal mobile telephone which was activeand located on the flightdeck.

As mobile cellular telephones move from one cell to another theytransmit an identifying code to the new cell. This occurs evenif the telephone is not being used to make a call. The CAA havealready identified this problem and issued an Aeronautical InformationCircular (AIC 96/1993) emphasising that the use of cellular telephonesin aircraft even in the 'standby mode' is prohibited by the AirNavigation (No 2) Order.

Recording systems discussion

There are several specifications concerningthe use of flight recording systems. The requirements and theequipment specifications are currently covered by the Air Navigation(No 2) Order and CAA Specifications 10 and 10A respectively. However, as the trend to European harmonisation continues, thesewill be superseded by JAR OPS and Eurocae ED-55. It should benoted that ED-55 is already in operation for the certificationof new designs and installations. The requirements governingmaintenance practices are contained within JAR 145 but there isno requirement for organisations that conduct mandatory readoutsas a part of scheduled maintenance activity to hold JAR 145 approvalfor the task. In order to address the ability of readout organisationsto assess recorded data adequately as part of a scheduled mandatoryreadout and to allow the regulatory authority to ensure an adequateassessment it is recommended that:

Recommendation 97-60

The CAA should require that organisationswhich conduct scheduled mandatory readouts of digital flight datarecorders are approved to JAR 145.

Recommendation 97-61

The CAA should require that an aircraft operatormaintains, for each recorder installation type, a data frame layoutdocument which contains; details of all parameters recorded, thelayout of the recorded data and the algorithms required to convertthat data to engineering units. The layout of the document shouldbe of a format standard to be stipulated by the CAA.

Recommendation 97-62

The CAA should require that, prior to a scheduled mandatory flightdata recorder readout being conducted, the aircraft operator shallensure that the facility conducting the readout is provided witha copy of the data frame layout document applicable to the installationto be assessed.

Recommendation 97-63

The CAA should require that an organisation conducting scheduledmandatory readouts from a digital flight data recorder has proceduresin place to ensure that all information, within a data frame layoutdocument, is correctly interpreted, used for a scheduled mandatoryreadout of the relevant recording installation and that any assessmentis conducted only on data that has been converted to engineeringunits. Furthermore any report issued by the organisation shallreference, both by document number and issue status, the dataframe layout document against which the readout was performed.