Final Report
of the Federal Aircraft Accidents Inquiry Board

concerning the Accident of the aircraft DC-9-32, ALITALIA, Flight No AZ 404, I-ATJA
on the Stadlerberg, Weiach/ZH, of 14 November 1990

The legal assessment of the accident is no concern of the investigation and the investigation reports (Art. 2, Par. 2 of the Ordinance of 20th August 1980 relating to aircraft accident investigations).
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According to Annex 13 of the International Civil Aviation Convention, paragraph 3.1 the purpose of aircraft accident investigation is the prevention of accidents. It is not the purpose of the aircraft accident investigation and the investigation report to apportion blame or to assign responsibility. This basic rule is also contained in the Federal Ordinance for Aircraft Accident Investigation of 20 August 1980 Art. 2 (VFU).
### SUMMARY OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ADF</td>
<td>Automatic Direction Finding Equipment</td>
</tr>
<tr>
<td>ADI</td>
<td>Attitude Director Indicator</td>
</tr>
<tr>
<td>AFM</td>
<td>Aircraft Flight Manual</td>
</tr>
<tr>
<td>AMSL</td>
<td>Above mean sea level</td>
</tr>
<tr>
<td>AGL</td>
<td>Above ground level</td>
</tr>
<tr>
<td>AIP</td>
<td>Aeronautical Information Publication</td>
</tr>
<tr>
<td>AND</td>
<td>Attitude nose down</td>
</tr>
<tr>
<td>ANU</td>
<td>Attitude nose up</td>
</tr>
<tr>
<td>AP</td>
<td>Autopilot</td>
</tr>
<tr>
<td>APP</td>
<td>Approach Control</td>
</tr>
<tr>
<td>COM</td>
<td>Communications</td>
</tr>
<tr>
<td>CVR</td>
<td>Cockpit Voice Recorder</td>
</tr>
<tr>
<td>DME</td>
<td>Distance-Measuring-Equipment</td>
</tr>
<tr>
<td>DFDR</td>
<td>Digital Flight Data Recorder</td>
</tr>
<tr>
<td>FAP</td>
<td>Final Approach Point</td>
</tr>
<tr>
<td>FD</td>
<td>Flight Director</td>
</tr>
<tr>
<td>FL</td>
<td>Flight Level</td>
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<tr>
<td>FOM</td>
<td>Flight Operations Manual</td>
</tr>
<tr>
<td>FVL</td>
<td>Air Traffic Controller</td>
</tr>
<tr>
<td>GP</td>
<td>Glide Path</td>
</tr>
<tr>
<td>GPWS</td>
<td>Ground Proximity Warning System</td>
</tr>
<tr>
<td>HDG</td>
<td>Heading</td>
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<tr>
<td>HSI</td>
<td>Horizontal Situation Indicator</td>
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<tr>
<td>IFR</td>
<td>Instrument Flight Rules</td>
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<tr>
<td>ILS</td>
<td>Instrument Landing System</td>
</tr>
<tr>
<td>LOC</td>
<td>Localizer</td>
</tr>
<tr>
<td>LT</td>
<td>Local time</td>
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<tr>
<td>MSA</td>
<td>Minimum safe altitude</td>
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<tr>
<td>NAV</td>
<td>Navigation receiver</td>
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<tr>
<td>NDB</td>
<td>Non-directional radio beacon</td>
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<tr>
<td>NSU</td>
<td>Nav switching unit</td>
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<tr>
<td>PAPI</td>
<td>Precision Approach Path Indicator</td>
</tr>
<tr>
<td>RMI</td>
<td>Radio Magnetic Indicator</td>
</tr>
<tr>
<td>QFE</td>
<td>Atmospheric pressure at aerodrome elevation or at runway threshold</td>
</tr>
<tr>
<td>QNE</td>
<td>Altimeter subscale to 1013.2 hectopascals</td>
</tr>
<tr>
<td>QNH</td>
<td>Corrected mean sea level pressure</td>
</tr>
<tr>
<td>VASIS</td>
<td>Visual approach slope indicator system</td>
</tr>
<tr>
<td>VHF</td>
<td>Very high frequency</td>
</tr>
<tr>
<td>VOLMET</td>
<td>Meteorological information for aircraft in flight</td>
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0. SYNOPSIS

0.1 Summary

Flight AZ 404 departed from Milan - Linate airport on the 14th November 1990 at 1836 hrs* with the destination Zürich. After a problem free flight, the crew were cleared by Zürich Approach to descend to 4000 ft (QNH) and to make an approach on the ILS 14.

At 14 NM from the threshold of RWY 14, the aircraft captured the localiser 14 and at about 11.5 NM descended through the cleared altitude of 4000 ft, instead of, as prescribed, leaving it when intercepting the glide path at 8 NM.

The aircraft descended with a constant rate of descent during the whole final approach, about 1400 ft below the correct glide path. At 1911 hrs, 5.2 NM from runway 14, the aircraft first struck the trees, and then the surface of the wooded north-face of the Stadlerberg.

After the collision a fire started. The 40 passengers and 6 crew members were fatally injured, the aircraft was destroyed. There was also considerable damage to the forest.

0.2 Investigation

The accident occurred at 1911 hrs. It was reported to the Aircraft Accident Investigation Bureau (AAIB) at 2050 hrs. Subsequently, this led to the first meeting in Berne where, in accordance with the Ordinance of the Federal Council for Aircraft Accident Investigation, the designated investigation team was alerted. The chairman of the Operations working group viewed the recording of radar data during the night at the Air Traffic Control Centre in Zürich. The following morning, the remainder of the team was called to the site at Weiach, organised by the police of the Kanton of Zürich. An earlier call to the accident site was not practical as the Police had first to secure the site, and the Fire Brigades were still fighting the fire. During this time, having arrived during the night, the Investigator in Charge and his team tried to obtain an overview.

The first meetings of the investigation team were held at Weiach, and subsequently, after the clearance of the accident site, at Zürich Airport.

In accordance with Annex 13 of the ICAO convention on International Civil Aviation, the state of registry and the state where the aircraft was manufactured have the right to send an accredited representative to the investigation. Italy as the state of registry and the USA as the state of manufacture, both made use of this facility. In addition, the manufacturer of the aircraft, McDonnell Douglas USA, and the operator ALITALIA actively assisted, producing important

*) All times are UTC (local time -1 hour) unless specified otherwise
data without which the report could not have been completed. The Flight Data Recorder and the Cockpit Voice Recorder were found early on. The opening of the respective cassettes and the reading out of the data was done by the British Air Accidents Investigation Branch (AAIB) in Farnborough GB.

The investigating team was comprised as follows (only chairmen of the working groups):

**Investigator in Charge:** K. Lier - Chief Inspector Aircraft Accident Investigation Bureau (AAIB) of the Federal Transport and Energy Department

**Operations:** H.-P. Graf - Investigator AAIB

**Weather:** K.H. Hack - Aviation Meteorological Office Zürich

**Air Traffic Control:** H.-P. Hulliger - Federal Office for Military Airfields

**Witness Statements:** Dr P. Oswald - Lawyer

**Human Factors:** Dr U. Baumann - Medical Doctor

**Technical Groups:** J. Overney - Investigator AAIB

**Structure:** K. Kaiser and R. Eberhard - Federal Office for Military Airfields

**Power Plant:** M. Häfliger - Federal Office for Military Airfields

**Systems:** J. Overney - AAIB

**Flight Recorders:** H. Keller - SWISSAIR

**Forensic Analysis:** Dr M. Hubmann, Dr R. Pfister, M. Signer, M. Jenni - all from the Scientific Service (WD) of the Zürich City Police

**Accredited Representatives:**

**State of Registry (Italy):** Dr A. Di Giulio, Head of the Ufficio Sicurezza Volo of the Italian Ministry of Transport, Rome

**State of Manufacture (USA):** R. Benzon - Investigator, National Transportation Safety Board, Washington DC
The investigation was supported by the Zürich Kantonspolizei (statements, photographies, and measurements) and by the Public Prosecutor of Dielsdorf.

The preliminary investigation was closed when the Investigation report and the Specialist Group reports of 9 December 1991 were presented to the President of the Commission on 17 January 1992.

In accordance with the standards of ICAO Annex 13, the report will be translated into an ICAO language namely English. In consideration of the State of Registry, an Italian translation of the final report will also be published.

The public hearing as required by the VFU article 32, was held on 10 March 1992 at the Federal Institute of Technology in Zürich.

On several meetings the Board established a final report dated 24 June 1992 and sent it to the interested parties. Their reconsiderations and a letter from the accredited representative of USA were debated on a meeting on 27 January 1993. At this date the final report was closed.

1. FACTUAL INFORMATION

1.0 Background

The cockpit crew of ALITALIA flight AZ 404 had a layover of 15:20 hrs in an hotel. They had already flown a rotation together on the day prior to the accident.

On the 14th November 1990, the crew checked in for flight duty at Milan-Linate at 1300 hrs. They were rostered for a return flight Milan-Linate (LIN) to Frankfurt (FRA), followed by LIN to Zürich (ZRH) and back. DC-9-32 I-ATJA was planned for all four legs.

The aircraft arrived in LIN from Düsseldorf (DUS) at 0927 hrs. The inbound crew who had flown I-ATJA to LIN left the following entries in the Technical Logbook (Quaderno tecnico di Bordo) on page 22, Flight DUS-LIN:

"1. VHF NAV 2: In Radio Selector position Radio 2 VHF-NAV 2 does not give a TO-FROM indication on HSI 2. In position Approach no TO-FROM indication on HSI 2."

"2. CAT II Simul. Appr. At 200 feet the autopilot had a tendency to fly under the glide path then to return to it followed by a accentuated "dive". The autopilot was switched off and we continued manually."

The take off in LIN for FRA was at 1407 hrs with a Captain (PIC) and a First Officer (COPI) as the cockpit crew. In FRA, apart from changing a Ground Flood Light no maintenance was undertaken on I-ATJA.
After the flight FRA - LIN, the PIC made no entry in the Technical Logbook. The PIC explained the technical situation to the mechanic verbally: The Failure had now been observed in position "RADIO 1". As a result of these observations, both VHF-NAV receivers were replaced. The crew were asked to make a "Simulated CAT II" approach in ZRH so that the aircraft could gain its full CAT II status for the return flight to LIN. The weather situation indicated a tendency towards CAT II conditions for the landing in LIN.

1.1 History of the Flight

The history of the flight could be determined on the basis of the Radar, DFDR and the CVR recordings. (Appendices 2, 3, 4, 5, 6 and 6a).

On the 14th November 1990 ALITALIA flight 404, aircraft type DC-9-32 registration I-ATJA, took off from runway 36R at LIN bound for ZRH. The flight was a scheduled commercial flight. The clearance was to the destination airport Zürich, via a CANNE IC departure to Flight Level 120, the transponder code 0302. The PIC assumed the duties of assisting pilot and dealt with the radio-telephony. The First Officer was the handling pilot. The take-off was at 1836 hrs. The standard climb via CANNE towards Airway A9 to the cruising flight level of 200 was trouble free.

About 2 minutes after reaching Flight Level 200 the crew listened to Zürich VOLMET. From this they gathered that the surface wind at Zürich was 240/08 kt. This led the PIC foresee a landing on runway 28. Having heard from the ATIS that the landing runway was 14, the crew still discussed a right hand circling approach for a landing on runway 28. The discussion continued considering a left hand circling to runway 28.

At 1852.53 hrs, from a QNH of 1019 hPa the crew worked out a QFE of 970 hPa. During the descent, the crew discussed the approach procedure for runway 14, where the Copilot mentioned the Outer Marker height for runway 16. After the discussion about the setting of the navigation aids, they also discussed the procedure to be followed in the event of a communications failure. The crew were instructed that following radar vectors they should fly an ILS approach for a landing on runway 28. The discussion continued considering a left hand circling to runway 28. At 1900.01 hrs the Copilot said "We perform a CAT II (approach)". The PIC was in agreement because the navigation equipment had to be checked. Whilst verifying the decision height, it transpired that the Copilot was still consulting the approach chart for runway 16. Further lengthy discussions about the setting of the required navigation aids followed. As the aircraft passed abeam Zürich descending to Flight Level 90, the PIC noted: "We are by KLOTEN, FL 90. He is bringing us in high". Clearance to descend to Flight Level 60 followed at 1902.28 hrs. At 1902.50 hrs ALITALIA 404 was instructed to fly heading 325. VHF NAV 1 was tuned to Trasadingen VOR (TRA), VHF NAV 2 to Kloten VOR (KLO). To define the fix at EKRON, the course 068 was also set. At 1904.32 hrs the PIC repeated "The outer marker is at 1200 ft (QFE), it can be verified by 3.8 [NM] from Kloten. Rhein (RHI NDB) 5.6 [NM]...". At 1905.15 hrs a new heading was required which the PIC confirmed. The identification of the ILS - 14 was registered on the CVR at 1905.32 hrs. At 1906.20 hrs, together with the approach clearance to runway 14, a new heading of 110, descent to 4000 ft and
the QNH of 1019 hPa was given. The PIC confirmed this clearance, however the heading was read back as 120. The incorrect readback of the clearance by the PIC caused the Copilot some uncertainty of the required heading to be flown. The PIC confirmed the approach clearance and the cleared altitude 4000 ft to the COPI, whereby the COPI ordered "RADIO APPROACH...". At this point an altitude of about 5000 ft (QNH) was passed. One of the pilots asked the other whether he had a Glide Path indication. The aircraft position was just before interception of the Localiser passing an altitude of about 4700 ft (QNH) (according to radar and DFDR). It was already about 1300 ft below the Glide Path. Answering the question about the Glide Path, the other pilot replied (hardly understandable) "On 1...I don't have...." Consequently the PIC said: "Good, so let's do it on 1". The COPI then ordered "RADIO 1". The flaps were probably set to 15°. In the mean time, the aircraft had passed through the localiser and was now slightly east of it. About the same time as the PIC said "Capture LOC capture glide path capture - so we are on the localiser, a little off track but...", the aircraft descended through 4000 ft (QNH) (about 11.5 NM from the threshold runway 14). It was thus about 1200 ft below the glide path. The QFE 970 hPa was also set by the COPI. About 5 seconds later the Altitude Exit Alert was heard (Descent through 3700 ft [QNH]). The PIC cancelled the warning by setting 5000 ft (Go Around Altitude) on the Altitude Preselect. The PIC said to the COPI: "There is another one (Finnair 863) in front quite close. You can reduce even further to 150 (kt) otherwise we'll end up with a "go around".

A discussion followed about possible icing. After this the flaps were set to 25 during which no Landing Gear horn was heard. At this point the aircraft was established on the localiser. The altitude was about 3000 ft QNH - ca. 1200 ft below the glide path. The PIC: "Outer Marker check is at 1250 ft [QFE]". The height was now about 1600 ft QFE. 10 seconds after Flaps 25, the flaps were set to 50. The Outer Marker height of 1250 ft QFE was now passed. The PIC said "Bravo" followed by sounds of switching. At 8 NM final the PIC mentioned "3.8 almost 4 miles". At about 7 NM final, (15 seconds after the PIC's words "Almost 4 miles") the COPI asked "... haven't we passed it?". After a further 12 seconds the COPI asked once again "Didn't we pass the outer marker?" The height was now 670 ft QFE. The PIC's answer was "No no it hasn't changed yet ...". At 6.6 NM final the PIC said "Oh it shows 7 ...". The crew was now ordered by Zürich ARR to change frequency to Zürich TWR. At 6.25 NM final the pilots conversed as follows: "... That doesn't make sense to me ...", "Nor to me ..., 2 seconds after this conversation the PIC called out "Pull, pull, pull, pull!!" Simultaneously autopilot disconnection could be heard. The position was now about 500 ft AGL overhead Weiach - about 350 ft QFE. 2 seconds later the COPI called out "GO AROUND", the PIC responded with "No no no no ... catch the glide!". At this point the DFDR shows a pitch change from -2° [AND] to +5.4° [ANU]. At the same time the thrust was increased from 1.3 to 1.7 EPR. The sink rate decreased from 1100 ft/min. to 190 ft/min. After 11 seconds (the pitch oscillated at +1° [ANU]) the PIC asked "Can you hold it?" to which the COPI replied "Yes". One second after the COPI's answer the Radio Altimeter warning (pip pip pip) indicating 200 ft/AGL could be heard. During this, the PIC said "Hold on let's try to ...". At 1911.18 hrs the aircraft struck the northern slope of the Stadlerberg at a altitude of 1660 ft QNH.
Grid Reference: 675 900/266 600. (= E008° 26’ 51’’/N047° 32’ 50’’). Elevation: 510 metres AMSL.

Location of the accident site: Map 1:25 000m Sheet No 1051, EGLISAU.

1.2 Injuries to Persons

<table>
<thead>
<tr>
<th>Crew</th>
<th>Passengers</th>
<th>Others</th>
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</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>6</td>
<td>40</td>
</tr>
</tbody>
</table>

1.3 Damage to Aircraft

Destroyed.

1.4 Other Damage

Considerable damage to about 600 m² forest due to impact and fire.

1.5 Personnel Information

1.5.1 Pilots

1.5.1.1 Captain (PIC)

+Italian citizen, born 1943.

ATPL issued by the Italian CAA valid until 28th December 1990.

IFR Checks (DC-9 - 32):

| Simulator: | 27 FEB 1990 inc. CAT II |
| Simulator (Base Check): | 29 AUG 1990 inc. CAT II and emergency procedures |
| Line: | 20 NOV 1989 GVA/FCO/CDG/PSA/TRN/BCN |
| Qualification: | All passed as PIC |

Flying Experience

| Total: | 10193 hrs |
| On accident type: | 3194 hrs |
| As PIC: | 1193 hrs |
| Last 90 days: | 116 hrs 03 min |
| Last 30 days: | 41 hrs 38 min |
| Last 24 Hrs: | 4 hrs 03 min (Before the accident flight) |

He entered service with ALITALIA on 15th May 1970. His military flying experience was about 1200 hrs. He had flown about 8000 hrs as COPI on DC-8, DC-9 and B-727 aircraft, and had been operating as Captain (PIC) on DC-9 -30 since 15th March 1988.
The last licence medical check on 26 June 1990 found him fit without restrictions.

His last landing in ZRH was on 31st May 1990 with AZ 414 LIN-ZRH.

1.5.1.2 First Officer (COPI)

+ Italian citizen, born 1962.

ATPL issued by the Italian CAA, valid until 18th April 1991.

IFR Checks (DC-9 - 32):
- Simulator: 11 FEB 1990 inc. CAT II
- Simulator (Base Check): 16 AUG 1990 Emergency procedures
- CAT II 24 AUG 1990 (although officially incorrectly recorded)
- Line: 11 JAN 1990 FCO/VRN/TRN/PAR/BOA
- CAT II expired: 11 AUG 90
- Qualification: All passed as COPI

Flying Experience

- Total: 831 hrs
- On accident type: 621 hrs (as COPI)
- Last 90 days: 108 hrs 10 min
- Last 30 days: 28 hrs 08 min
- Last 24 Hrs: 4 hrs 03 min (Before the accident flight)

He received his pilot training from ALITALIA, after which he was employed as a DC-9-32 Copilot as of 15th July 1989. The last licence medical check on 1st June 1990 found him fit without restrictions.

His last landing in ZRH was on 16 OCT 1990, Flight AZ 400 FCO-ZRH.

1.5.1.3 Flight Duty and Rest Time of the Pilots

<table>
<thead>
<tr>
<th>PIC</th>
<th>Flight Time</th>
<th>Duty Time</th>
<th>Rest Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 NOV 1990</td>
<td>3:07</td>
<td>5:14</td>
<td>15:20</td>
</tr>
<tr>
<td>13 NOV 1990</td>
<td>4:03</td>
<td>7:35</td>
<td>---</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>COPI</th>
<th>Flight Time</th>
<th>Duty Time</th>
<th>Rest Time</th>
</tr>
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<tbody>
<tr>
<td>14 NOV 1990</td>
<td>3:07</td>
<td>5:14</td>
<td>15:20</td>
</tr>
<tr>
<td>13 NOV 1990</td>
<td>4:03</td>
<td>7:35</td>
<td>---</td>
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</tbody>
</table>

The pilots flew together the day prior to that of the accident. Before these two working days, both pilots had more than 48 hrs off duty.
1.5.2 Cabin Crew

- Italian citizen, born 1947.
- Italian citizen, born 1954.
- Italian citizen, born 1960.
- Italian citizen, born 1967.

1.5.3 Air Traffic Controller


1.5.4 Passengers

There were 40 passengers on board.

1.6 Aircraft I-ATTA

Airframe:

- Type: DC-9-32
- Manufacturer: McDonnell Douglas, USA
- Serial No: 47641
- Airframe No: 746
- Construction Year: 1974
- Stick Hours: 33886 hrs
- Block Time: 43894 hrs
- Cycles: 43452

Maintenance Record:

<table>
<thead>
<tr>
<th>Check</th>
<th>Interval</th>
<th>Last Check</th>
<th>Hours since last check</th>
<th>Next Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISA</td>
<td>100 hrs</td>
<td>4.11.99 LHR</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>ISB</td>
<td>470 hrs</td>
<td>21.10.90 FCO</td>
<td>148</td>
<td>322</td>
</tr>
<tr>
<td>ISC</td>
<td>1800 hrs</td>
<td>2.6.90 NAP</td>
<td>1026</td>
<td>774</td>
</tr>
<tr>
<td>RED</td>
<td>12000 hrs</td>
<td>7.10.88 FCO</td>
<td>4438</td>
<td>7561 hrs/</td>
</tr>
<tr>
<td></td>
<td>62monts*</td>
<td></td>
<td></td>
<td>7.12.93*</td>
</tr>
</tbody>
</table>

* Whichever occurs first

Maintenance handover from ATI to AZ: 6.11.89 31632 hrs and 41487 cycles

Last renewal airworthiness certificate: 18.6.90
Power Plant:

Manufacturer: Pratt and Whitney
Type: JT8D-9A
Take Off Thrust: 14500 lbs
Maximum Continuous: 12600 lbs
Cruise: 11400 lbs

Engine: Serial No. 667030 (Left)

Installed in I-ATJA: 30.09.90

Engine operating times at the time of the accident:

| Time since installation (TSI): | 270 Hrs |
| Total "Stick Hours" (TT): | 31423 Hrs |
| Total "Block Hours": | 40393 Hrs |
| Total Cycles (TC): | 38994 |

Service times of the modules at the time of the accident:

<table>
<thead>
<tr>
<th>Mod No.</th>
<th>Serial No.</th>
<th>TT</th>
<th>TC</th>
<th>TSO</th>
<th>CSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>167033</td>
<td>31432</td>
<td>34706</td>
<td>5149</td>
<td>4573</td>
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<td>467102</td>
<td>27523</td>
<td>30964</td>
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<tr>
<td>5</td>
<td>566787</td>
<td>37247</td>
<td>40103</td>
<td>2865</td>
<td>2843</td>
</tr>
</tbody>
</table>

TT = TOTAL TIME
TC = TOTAL CYCLES
TSO = TIME SINCE OVERHAUL
CSO = CYCLES SINCE OVERHAUL

Engine: Serial No. 656952 (right)

Installed in I-ATJA: 11.02.89

Engine operating times at the time of the accident:

| Time since installation (TSI): | 3749 hrs |
| Total "Stick Hours" (TT): | 37931 hrs |
| Total "Block Hours": | 47484 hrs |
| Total Cycles (TC): | 41170 |
Service times of the modules at the time of the accident:

<table>
<thead>
<tr>
<th>Mod No.</th>
<th>Serial No.</th>
<th>TT</th>
<th>TC</th>
<th>TSO</th>
<th>CSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>156952</td>
<td>35919</td>
<td>37983</td>
<td>3749</td>
<td>3552</td>
</tr>
<tr>
<td>2</td>
<td>266784</td>
<td>37179</td>
<td>42819</td>
<td>3749</td>
<td>3552</td>
</tr>
<tr>
<td>3</td>
<td>366890</td>
<td>35696</td>
<td>37908</td>
<td>3749</td>
<td>3552</td>
</tr>
<tr>
<td>4</td>
<td>466724</td>
<td>38052</td>
<td>44042</td>
<td>3749</td>
<td>3552</td>
</tr>
<tr>
<td>5</td>
<td>566717</td>
<td>35454</td>
<td>34386</td>
<td>8833</td>
<td>8704</td>
</tr>
</tbody>
</table>

TT = TOTAL TIME
TC = TOTAL CYCLES
TSO = TIME SINCE OVERHAUL
CSO = CYCLES SINCE OVERHAUL

Engine Maintenance

Module No. 1, 2 and 3: 9000 CSO
Module No. 4: 5500 CSO
Module No. 5: 11000 CSO

Repair and overhaul work on the ALITALIA JT8D-9A is undertaken by Alfa Romeo, Aviation Division (ARAVIO) in Naples.

Last maintenance works by ARAVIO

Engine, Serial No. 667030

From 01.05.90 to 08.09.90 the following works were done on this engine:

Module No. 1: Extensive disassembly and check, and repair of sub-assemblies
Module No. 2 - " -
Module No. 3: Complete overhaul
Module No. 4 - " -
Module No. 5: Repairs

Engine, Serial No. 656952

From 22.09.88 to 28.01.89 the following works were done on this engine:

Module No. 1: Complete overhaul
Module No. 2 - " -
Module No. 3 - " -
Module No. 4 - " -
Module No. 5: Repairs with extensive disassembly and checks
Next Planned Work

Engine Serial No. 667030

The ND Turbine disc, stage 2 was due to be exchanged after a further 9470 cycles (residual life). The work was planned for 1995.

Engine Serial No. 656952

The outer combustion chamber housing was to be removed after a further 10442 cycles (residual Life) for FPI/FMPI in accordance with ASB 5676-AD87-11-07R1. The work would have been due in 1996.

Significant faults and defects since installation in aircraft I-ATJA

No significant events were registered in either engine.

Certificates and admission


Applicable Category: Public Transport (n-I/TTP-TPm-La)

Minimum Crew: 1 Pilot and 1 Copilot, 4 Cabin Crewmembers

Passengers: 107

Maximum Take Off Weight: 48989 kg

At the time of the accident, 5160 kg of fuel was on board.

According to the Loadsheet, the All Up Weight and Centre of Gravity were within certified limits.

1.7 Weather

1.7.1 During the departure phase, the line flight AZ 404 on 14th November 1990 (LIN - ZRH) passed through a cloud mass associated with an occlusion lying over northern Italy, in which there were no significant meteorological phenomena.

Over the Alps, the aircraft gradually entered the cold air mass which was moving in behind the occlusion. At Flight Level 200 the aircraft was occasionally out of the clouds (Tops 18000 - 20000 ft AMSL) which had formed behind the occlusion.

During the descent over northern Switzerland, the aircraft was flying mainly in cloud. Light icing was possible in this phase. Between 4400 ft and 3900 ft AMSL the aircraft came clear of the cloud.
Other aircraft on approach during the same period had the approach and runway lighting almost continuously in sight.

In the final phase it could be that the approach and runway lighting of Zürich Airport may have been obscured for an aircraft flying too low, by a cloud cap on the Stadlerberg.

1.7.2

ATIS on 128.520 MHz

Zürich information ECHO
Landing RWY 14
Take off RWY 28
Met report Zürich 1850
240 degrees 4 kts,
Final RWY 14 and 16 250 degrees 7 kts
Lift Off RWY 16 240 degrees 4 kts
visibility 10 Km
Mist
2/8 1500 ft
5/8 3000 ft
7/8 4000 ft
Temperature 9 dew point 8
QNH 1019, NOSIG
Transition Level 50

1.8

Navigation - Ground Equipment (Zürich Airport)

ILS 14 and other NAV-aids

The following aids are available for approaches to runway 14 at Zürich Airport and at the time of the accident were serviceable:

<table>
<thead>
<tr>
<th>Type of Aid</th>
<th>Callsign</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>ILS 14, CAT I/II/IIIa with DME (co-located with the GP: Distance 0 at THR 14), OM/MM</td>
<td>IKL</td>
<td>108.3 MHz</td>
</tr>
<tr>
<td>VOR/DME</td>
<td>KLO</td>
<td>116.4 MHz</td>
</tr>
<tr>
<td>VOR</td>
<td>ZUE</td>
<td>115.0 MHz</td>
</tr>
<tr>
<td>VOR/DME</td>
<td>TRA</td>
<td>114.3 MHz</td>
</tr>
<tr>
<td>NDB</td>
<td>RHI</td>
<td>332.0 KHz</td>
</tr>
<tr>
<td>NDB</td>
<td>SHA</td>
<td>371.5 KHz</td>
</tr>
<tr>
<td>NDB</td>
<td>WAL</td>
<td>360.0 KHz</td>
</tr>
</tbody>
</table>

Simultaneous use of the ILS by other aircraft

According to the radar recording, at the time of the accident, two other airliners were on approach - IBE 588 and FIN 863. There were no reports from these aircraft relating to problems with the ILS.
Checks before the Accident

Last calibration in flight

Last calibration: Glide Path 27 July 1990
Localiser 30 July 1990

These calibrations were conducted using equipment from the Austrian Civil Aviation Authority. An agreement between Switzerland and Austria enables this mutual service.
Result: ILS 14 is certified for CAT III operations.

Last ground calibration

Last ground calibration: 14th November 1990 (afternoon)
Result: The check showed no irregularities.

Check after Accident

At 2150 hrs LT the head of the Technical Navigation Services asked that the head of the Operations Service suspend approaches on the ILS 14.

About two hours after the accident a ground check of the 14 ILS installation was carried out by the responsible technical service under the supervision of a neutral intermediary.
Result: No irregularities were found.

On the 15th November between 0100 LT and 0300 LT the Airborne Calibration Unit (IAN) of the Federal Office for Civil Aviation (FOCA) executed a flight check of the most important parameters. Everything was found to be in order, so at 0400 LT the equipment was released for further service. Using this opportunity, all the other navigational approach aids were checked and found to be serviceable.

On the 16th November 1990 the Calibration Unit (TAN) executed a full in flight calibration of the 14 ILS installation.
Result: All parameters were found to be in order and the authorisation for the equipment to be returned to CAT III service without limitations was confirmed.

Remarks:
1. All measurements mentioned above were made without making any adjustments to the installations.
2. Weather conditions precluded a complete calibration of the installation before 16.11.90.

Calibration by Helicopter

On the 20th March 1991 an IFR equipped helicopter followed and recorded the actual flight path flown by AZ 404. As a result it could be determined that the GP signal could be received (Valid) until shortly before the accident site.
Communications Equipment

From the evidence of the Air Traffic Controllers involved, having listened to the voice recordings and from data from the Technical Service, the communications equipment (VHF-COM/ATIS) was found to be functioning satisfactorily at the time of the accident. This was also the case for all internal Air Traffic Control connections (Intercom, telephones).

The data from the VHF DF on the Holberg was available at the work stations and could be superimposed on the radar screens.

There was no evidence that the communications equipment had any influence leading to the accident.

Radar Equipment and Radar Displays

The Air Traffic Controllers have access to area displays based on one of many radar receivers. Data from the radar installations situated on the Lägern (Primary/Secondary), Holberg (only Analog Primary/Secondary), La Dôle (Primary/Secondary) and Gosheim, Germany, (Secondary) can be used for this purpose.

Information from the Lägern is the prime source for the Area Control Centre (ACC), whereas that of the Holberg is used by the Approach Control.

The following information is presented on '21 inch' Screens:

- Actual position of the aircraft (identified by a symbol) and its previous position
- Flight Number (or Callsign)
- Altitude (Mode C, Corrected to QNH below Transition Altitude)
- Ground Speed
- Primary radar returns can be displayed due to a phosphorous layer on the APP screens which allows a long after-glow.

In the TWR there is a limited distance presentation on a television (Bright Display).

Data from the Albis weather radar was presented on a separate display in the ACC and APP. All equipment referred to was functioning correctly according to the Air Traffic Controllers and the Technical Monitors.

An automatic "Minimum Safe Altitude" Warning system (MSA), standard in the USA, is not available.
Recordings

The following data is permanently recorded:

- All VHF radio channels
  (Multi-channel recording units and cassette recorders (short term recording) at certain stations)

- All land lines between work stations (Intercom)
  (Multi-channel recording units)

- All telephone conversations at the work stations
  (multi-channel recording units)

- Radar tracking data: Radar returns and runway returns of the Multi radar systems.
  (Magnetic tape recording, including two VHF channels - display on radar screens or hard copy on paper)

- Data from the TWR 'Bright Displays', analog and synthetic radar data
  (Video cassette, sequential recording - display on the 'Bright Display or hard copy on paper)

- The status of the navigation aids (ANIS - monitoring system, computer print-out)

- The status of the radar installations and the data processing systems
  (Computer print-out)

- Conversations in the radar room were not recorded by an area microphone.

- All sources of information and documentation were at the disposal of the ATC working group. All recordings confirmed the correct operation of the technical ground equipment.

Additional note

No faults were reported by other aircraft crews either prior to or following the accident.

Radio Traffic

The radio communications of AZ 404 with the Air traffic Controllers involved, presented no difficulties during the whole flight. The mutual comprehension was constantly good. The communications equipment on the ground and on board the aircraft was serviceable.
1.10 **Airport Equipment**

Runway 14 is not equipped with VASI (Visual Approach Slope Indication Systems) or with PAPI (Precision Approach Path Indicating Systems). The 637 m/AMSL high Stadlerberg which lies on the approach axis of runway 14 has no obstruction lighting.

1.11 **Flight Recorder**

The aircraft was equipped with a Digital flight data recorder (DFDR) and a Cockpit Voice Recorder (CVR).

1.11.1 **DFDR**

Manufactured by Sunstrand, the digital flight data recorder had the following parameters:

- Vertical acceleration
- Magnetic heading
- Pitch attitude
- Roll attitude
- EPR 1
- EPR 2
- VHF 1
- VHF 2
- Airspeed
- Pressure altitude

The casing showed fire damage, the interior had no signs of damage. The tape was dismantled and transposed both digitally and graphically by the British Air Accidents Investigation Branch at Farnborough GB. The graphic evaluation is attached as Annex 7.

1.11.2 **CVR**

A magnetic tape, manufactured by Sunstrand. As the casing had suffered physical damage, it had to be cut open. The protective cassette, electronics and the tape were damaged. Three tracks were used, namely VHF-COM Captain, VHF-COM Copilot and the Area Microphone. As the pilots did not make use of the headsets (including microphones), the cockpit conversations were taken entirely from the Area Mike (Installed in the overhead panel of the cockpit). The original tape was transferred to standard cassettes by the British authorities. The cockpit noise level, together with that of the ATC voice traffic on the cockpit speakers which were set to a high volume, impaired the interpretation of the conversations between the pilots which were held in the Italian language. In an effort to optimise the interpretation of these conversations, the facilities of both the Federal German Accident Investigation Branch at Braunschweig and the Laboratory of the Directorate of Research and Development of the Swiss PTT in Berne were used.
The transcript of the recordings, both in the original Italian language and an English translation, are attached to the report as Annexes 6 and 6a.

1.12 Wreckage and Impact Information

The accident site was situated on the northern slope of the Stadlerberg, a wooded hill (highest elevation 637 m/AMSL, -200 m above the immediate surroundings).

The right engine, which was severely damaged, lay at the edge of the main wreckage area separated from the aircraft tail unit. The left engine was still attached to the tail unit and was largely intact.

By using the impact/damage trail the final Flight Phase could be determined:

The aircraft contacted the first trees in an essentially level flight path and with no roll angle, mainly with the right wing and forward fuselage. This is evident from parts found near the first trees to be damaged: wing leading edge/slat, parts of the green position light cover on the outer right wing and the rear nose-gear door. At this point essential parts of the control systems (electronics) were probably damaged. As a result of the destruction, particularly in the right wing area, the aircraft received an asymmetric lift force which lead to the next impact point with the trees having a considerable right wing low attitude. The aircraft turned itself further about its longitudinal axis to the right until it struck the ground, where the right engine was torn off before the tail unit finally separated, and the fuselage (together with the occupants) impacted the steep hillside.

1.13 Medical and Pathological Information

The mortal remains of the pilots were given a post mortem where possible by the Zürich Pathological Institute (GMI). The cause of death in both cases was injuries received during the accident and the effects of fire. There was no evidence of any relevant pre-existing health problems.

Samples were taken from the bodies of both pilots and were subjected to chemical and toxicological tests. In summary the Chemical Service of GMI Zürich records that:

"In the case of the Captain, there is no evidence of significant toxic substances."

There were no signs of the presence of medicaments or drugs in the Copilot. However various levels of Ethyl Alcohol concentration between 0.02 0/00 and 0.38 0/00 were found in the body tissue and blood. It can not be proven whether this alcohol presence was caused by alcohol consumption whilst alive or the effects of bacteriological production after death."

1.14 Fire

The aircraft caught fire immediately after the accident. This spread rapidly although not over the immediate surroundings. The fire brigades from Weiach, Büllach, Dielsdorf, Glattfelden (all Zürich) and from Hohentengen (Germany), and in addition
the Airport Fire Service from Zürich and the Company Fire Service from Swissair, were all soon at the scene where they immediately began fighting the fire, thus preventing a serious forest fire from starting. The fire could only be completely extinguished towards the evening of the following day, as the first fire fighting was done using water spray in order to prevent unnecessary damage to the debris for the investigation.

Amongst other reasons, the cause and the duration of the fire can be traced back to the 5160 kg (6450 l) kerosine in the wing tanks.

1.15 Survivability

Those aircraft occupants who were not fatally injured in the accident, died from burns or from smoke poisoning. The accident was not survivable.

Had there been some survivors, optimal medical support was available due to the close proximity of the airport and the trained Airport First Aid Service.

1.16 Tests and Research

1.16.1 Investigation of the navigation System in the Aircraft (NAV - DME, GPWS)

From the CVR recordings it was evident that as the aircraft intercepted the localiser, the crew at first had difficulties in receiving the glide path signal and selected mode RADIO 1 for the final approach whereby, at about 12 - 13 NM (distance from the runway), they received a glide path signal. The PIC reported "capture LOC, capture glide path capture, so we are on the beam a little off track, but....". Accordingly the crew were of the opinion that the aircraft was on the ILS, a little offset to the east (this small initial offset caused by a slight overshoot of the LOC, is confirmed by the radar recording). The aircraft was in fact on the localiser however it was about 1300 ft beneath the glide path. This is also evident from the radar recording.

A reconstruction was made on the 9th March 1991 using an aircraft of the same type (same equipment) belonging to ALITALIA (similarly the AZ 404), where the flight path was followed exactly down to an altitude of 4000 ft QNH. As a result it was determined that until GP interception, the glide path needles on all four instruments was in the fully UP position; that is out of sight. On the 20th March 1991, using an IFR equipped helicopter, approaches were made right down to the accident site following data from the accident flight. The glide path indications remained in the fully UP position although in one instrument no warning flag appeared and in the other a flag appeared at a distance of 6.8 NM ILS/DME.

Because, on the one hand the PIC reported the presence of a glide path signal to his Copilot, although this was at a distance and height where no such glide path should occur, and on the other hand the test of the ILS installation undertaken immediately after the accident confirmed its correct operation, particular attention was focused on the aircraft's NAV equipment.
1.16.1.1 The Navigation Systems and their Indications

The DC-9-32, I-ATJA was equipped as follows:

- 3 COM - set (radio)
- 2 NAV receivers (VOR+ILS+GS)
- 2 DME, receiver frequencies controlled via NAV receivers
- 2 ADF
- 2 Flight Directors
- 2 Radio Altimeters
- 1 Autopilot
- 1 Marker receiver
- 2 Servo compasses (slaved gyros)

The Ground Proximity Warning System (GPWS) was not found.

The NAV equipment produced the following indications:

- The VOR signal was presented on 2 HSI and on 2 RMI with double pointers
- The DME distances were presented on the two HSI
- Both ADF on the two HSI
- The Flight Director controlled indications in the Artificial Horizons (ADI)
- Each pilot had a Radio Altimeter indication
- The GPWS gives an aural alarm and an order with a computer generated voice
- The marker receiver shows the position in the final approach with three lights and on behalf of acoustic signals
- Glide path and localiser are presented both on the artificial horizons and on the HSI
- The slaved gyros give the heading on the HSI and RMI and can be coupled to the Flight Director.

1.16.1.2 NAV receivers

1.16.1.2.1 History of the NAV receivers at ALITALIA

ALITALIA took over a number of DC-9-32 aircraft from ATI (Aero Transporti Italiani), amongst them I-ATJA. The ATI aircraft were equipped with KING receivers. The aircraft of the same type with ALITALIA were equipped with COLLINS units. The COLLINS and the KING receivers are completely inter-changeable. In time these units became fully intermixed.

1.16.1.2.2 Monitoring of the Output Signal of the NAV Receiver

A major disadvantage of the analog ILS systems is that when no output signal is produced by the NAV receiver (GS and LOC) the same indication is given as in the "On Course" or "On Glide Slope" case. This situation could occur with a short circuit or a signal break between the receiver output and the indicator (eg: HSI, ADI).
A monitored receiver (eg: COLLINS -109) is able to detect this type of failure and to present a failure flag.

The KING KNR 6030 NAV receiver is essentially not monitored in this way.

The accident aircraft DC-9-32, I-ATJA was fitted with one KING KNR 6030 and one COLLINS 51RV-2B (P/N 522-4280-108) NAV receiver, that is equipped with two unmonitored units.

1.16.1.2.3 Description of the Glide Slope (GS) Receivers KING KNR 6030

The glide slope reception unit consists primarily of:

- HF-receiver
- Mixer 1st and 2nd
- Synthesiser (phase locked loop)
- IF (Intermediate Frequency Stage)
- Demodulator (150/90 Hz composite signal)
- Automatic Amplification Regulator

In the circuit, the Deviation Detector derives the GS deviation signal from the composite GS signal and presents the information on the cockpit instruments via a deviation driver. The glide slope signal is passed from the Deviation Driver (printed circuit board) via a "Motherboard" (also a printed circuit board) and a cable loom to a rear-mounted equipment plug.

The flag circuit monitors the receiver part and the deviation detector. The deviation driver together with the subsequent signal routing then remains unmonitored. A valid signal (Warning flag in the instrument out of view) means that an adequate signal (more than 10 micro volts) is available at the entry port, and that the modulation (150/90 MHz) lies within tolerance.

The frequency is selected by means of the NAV/DME control panel on the glareshield. With the Flight Director Control selector in position RADIO 1 or RADIO 2, the frequency of NAV receiver 1 will be set by the left NAV/DME control panel, and that of the NAV receiver 2 by the right control panel. However in the position APP, both NAV receivers will be tuned to the frequency on the left NAV/DME control panel.
By using a self test, both the localiser and the glide slope receivers can be tested simultaneously. As a result, an internally produced test signal will be fed to the second mixer stage of the respective receiver. With the exception of the antenna and the first mixer stage, practically the whole receiver will be checked during a self-test. On the instruments, the indicator needles will move to the position of the self-test button - either UP/LEFT or DOWN/RIGHT. The warning flag disappears momentarily and reappears as long as the test button is pushed.

Block Diagram KING KNR 6030 GS Receiver

1.16.1.2.4 Previous History of the NAV receivers fitted at I-ATJA

On the flights immediately prior to the accident flight, there were complaints about the TO/FROM indication on the Copilot's HSI. This was during a flight from DUS to LIN. In LIN the NAV units were swapped. After a crew change, I-ATJA flew to FRA. Following the swap the fault was identified. There was also a complaint about oscillations on the glide slope during a coupled approach (ca. 200 ft). This complaint was most probably attributed to the autopilot. I-ATJA then flew back to LIN.
1.16.1.2.5 Unit exchange in LIN

Having landed after the flight from FRA, I-ATJA was parked on position 16 at LIN. Two ALITALIA employees changed both NAV receivers for a KING receiver KNR 6030, S/N 2256 in the NAV system 1, and a COLLINS 51RV-2B in the NAV system 2. A self test was conducted on both systems. Following this both technicians checked the functioning of the equipment in the NAV mode, in that they switched off the signals of the LIN VOR and that of the LIN localiser. However it was not possible to test the reception of the ILS glide slope signals due to the parking position of the aircraft.

This is how, I-ATJA was released to service, with the status COUPLED APPROACH CHECK. This status could be proven after the accident as the STATUS MODE INDICATOR was recovered. According to ALITALIA procedures, the pilots are required to execute a automatic approach in weather conditions of CAT I or better so that the status COUPLED APPROACH ALLOWED can be achieved.

1.16.1.2.6 Workshop History of NAV receiver KING KNR 6030

Based on documentation produced by ALITALIA, it can be assumed that the NAV receiver KING KNR 6030 S/N 2256 fitted before the accident flight was serviced in the workshop in accordance with standard procedures. The prior history of the receiver gave no negative indications.

1.16.1.2.7 Investigation of NAV receiver KING KNR 6030

Based on the cockpit conversations, it can be assumed that the crew believed that there was a problem with GS Signal No 2, and therefore switched from APPROACH to RADIO 1. Based on the flight progress, it must be assumed that GS indication No 1 was unreliable. Therefore the investigation was concentrated on NAV receiver No 1.

The receiver KING KNR 6030, S/N 2256 was recovered from the accident site in a badly damaged condition. The unit was considerably deformed and had fire damage. The aircraft plug had been ripped from the cable loom, and separated from the radio rack and was found on the receiver unit. There was no sign of pre-accident damage on this plug.

In the NAV receiver itself, the glide slope deviation signal circuit was followed from the rear mounted unit plug until the interface board. At the transfer between the cable loom and the mother-board a break was detected at the connections E2644 and E2648. The specialists from the Zürich Police Scientific Service (WD) determined that no pre-accident damage was present at this connection. The circuits on both the mother-board and the interface-board were intact.

The condenser C2914 on the interface-board was destroyed and could not be tested. The same is valid for CR2901.
The IC I 2903 in the glide slope deviation driver was missing. The IC I 2904 in the VOR/LOC deviation driver was found loose in the unit. The Scientific Service specialists determined that both IC must have been pulled from their respective receptacles by acceleration forces.

A detailed examination of the interface-board was not possible due to the high degree of damage. It is noted however, that a fault in an electronic component on this board would tend to have caused a hard-over, rather than a centred indicator needle.

The examination of the NAV receiver KING KNR 6030 gave no firm indications of a pre-crash deficiency. It can not, however, be excluded that this unit could have accounted for a "frozen" centred glide slope indication.

1.16.1.2.8 Information from ALITALIA

On the 12th June 1991 ALITALIA informed the Investigator in Charge that:

During an approach a centred LOC indication without a warning flag had been reported. The defective KING KNR 6030 receiver had been removed. The defect could be verified in the workshop. A cold solder in the deviation driver circuit could be identified as the cause of the "frozen" indication.

It can not be excluded that a similar fault in the GS deviation driver unit could lead to a "frozen" GS indication.

1.16.1.3 NAV receiver Switching Unit (NSU)

The ALITALIA DC-9-32 has, as already mentioned, two NAV receiver units. The pilots have the choice of selecting as a source for their indicating instruments (HSI 1 + 2, ADI 1 + 2) NAV receiver 1, 2 or separated, as desired. This switching is effected by a NAV Switching Unit between the NAV receivers and the indicating instruments.
1.16.1.3.1 Description of the NAV Switching Unit

The NSU consists of a number of rotary switches which are positioned by a motor. The motor receives its control signals from a RADIO switch which is located on the Flight Director Control Panel.

Block Diagram of the NAV System

The RADIO switch has three positions (Annex 8 + 9):

- RADIO 1: All indicators (HSI 1 + 2, ADI 1+2) receive signals from the output of NAV receiver 1.
- RADIO 2: All indicators (HSI 1 + 2, ADI 1+2) receive signals from the output of NAV receiver 2.
- APP: HSI 1 and ADI 2 are fed from NAV receiver 1. HSI 2 and ADI 1 are fed from NAV receiver 2.

The selected frequencies are also changed by the same NSU.

- RADIO 1: NAV receiver 1 = frequency selector pos. 1
- RADIO 2: NAV receiver 2 = frequency selector pos. 2
- APP: NAV receiver 1 + 2 = frequency selector pos. 1
The frequency selection of the DMEs is not influenced by the NAV switching unit.

The NSU is located in the avionics compartment.

1.16.1.3.2 Manufacturer's Information

On the 22nd July 1984 the aircraft manufacturer DOUGLAS issued an ALL OPERATOR LETTER. In this letter, the possibility of a "frozen" glide or localiser indication without a warning flag was described.

DOUGLAS specified two NAV receiver groups:

1. Receivers which did not have a localiser and glide slope output signal monitor.

2. Receivers with the respective monitoring.

In the group of monitored units, DOUGLAS assumed that all COLLINS 51RV-2B units had been modified to -109 (With Monitoring) status, as COLLINS had previously recommended in 1975. The false assumption by DOUGLAS about the COLLINS units, may have led to certain DOUGLAS customers as with ALITALIA not being alerted, and thus continuing to operate with unmonitored (-108) units.

At ALITALIA, the COLLINS receivers were not modified and at the time of the accident were still of -108 status.

On the 17th April 1985 DOUGLAS conducted a seminar in the USA on the subject: "HSI/GLIDE SLOPE UNFLAGGED FAILURES"

Amongst others, Captains from ALITALIA and ATI took part in this seminar. During this seminar attention was once again drawn to the dangers of "unflagged glide slope failure" in connection with NAV switching.

1.16.1.3.3 Examination of the NSU of I-ATJA

The NSU from I-ATJA, P/N 600 916-101, S/N 222 (series 002) manufactured by Butler National, was recovered from the accident site.

The condition of this unit allowed closer examination. As the rotary switch is positioned by an electric motor, it could not change position during the impact. The examination of the NSU showed that the switch position was undoubtedly RADIO 1.

Contrary to this, the RADIO switch on the Flight Director panel was recovered in the position APP. It must therefore be assumed that either one of the pilots moved the switch shortly before impact or it was shifted by mechanical force.

Finding the NSU in position RADIO 1 undoubtedly confirms the position which the pilots selected for the approach according to the cockpit conversations (CVR). During a routine approach with ALITALIA, the position APP would be used.
1.16.1.4 Examination of the Captain's HSI

The HSI was subjected to a trace examination by the Scientific Service (WD). As a result, a concentration of heavy impressions from the GP needle was found on the GP scale about 1/3 of a dot above the centre mark. A microscopic comparison of the impressions with a new GP needle confirmed this fact.

In addition it was also be found that at the time of the impact no warning flags were in the pilots' field of view.

The concentration of impressions about 1/3 of a dot above the centre mark can be explained as follows:

Before contacting the hillside, DC-9-32 I-ATJA first struck some trees. As a result it was turned against the hill face and only then struck the solid surface. In the accident the collision was a relatively long event. This had the result that during the whole collision, the GP needle vibrated both ways, i.e. vertically and horizontally. It can be assumed that the collision with the first trees moved the GP needle out of the centre position which would explain the concentration of impressions referred to.

1.16.1.5 Comparator

1.16.1.5.1 Description (see Annexes 8 and 9)

The ALITALIA DC-9-32 is equipped with a NAV instrument comparator. This compares, amongst other things, the deviation signals of the GP and LOC. It produces an optical warning for the pilot on the so called "Bow tie" indicator if a discrepancy is detected above a pre-determined threshold. This comparator is only active when the RADIO selector is in the position APP, i.e. when both NAV receivers deliver valid GP and LOC signals. In addition, the signal must be valid.

In position RADIO 1 or RADIO 2, (i.e. NAV 1 or NAV 2) the comparator is not active.

1.16.1.5.2 Examination of the Comparator

The comparator of I-ATJA was recovered from the accident in a considerably damaged state. A closer examination of this unit was impossible. There is a slight possibility that a short circuit in the GP signal input of the comparator could have caused a centred GP 1 indication (without warning flag).

1.16.1.6 Ground Proximity Warning System (GPWS)

ALITALIA DC-9-32 aircraft are equipped with GPWS. According to the ALITALIA documentation, a Sunstrand Mark II GPWS P/N 965-0476-088, S/N 5127 was installed. The GPWS belonging to I-ATJA was not recovered from the accident site and thus could not be examined.
The sound of a GPWS warning is never audible on the CVR. This played a significant role in the accident sequence.

1.16.1.6.1 Functional Analysis of the GPWS on the Accident Flight

In the final phase of the accident flight the following warning modes might apply due to the aircraft configuration (gear down, flaps down):

- Mode 1: Excessive sink rate
- Mode 2b: Excessive terrain closure rate
- Mode 5: Excessively below glide slope

Mode 1

As the sink rate was within the specified limits at all times, this warning can be ruled out.

Mode 2

Whilst overflying the Küssaberg Mode 2a was still active. At this point a closure rate of about 4000 ft/min would have been necessary for a warning to be triggered.

Having crossed the Rhein the flaps were extended to more than 15 so the GPWS changed to mode 2b. The fact that the "Terrain" warning did not occur could be traced back to a combination of flight profile and terrain profile.

Mode 5

As long as the landing gear was extended whilst overflying the Küssaberg, the GPWS should, at that point, have given a "BELOW GP" warning. In the region of Weiach, all conditions required for a warning were definitely fulfilled.

Possible reasons for the failure to occur:

- GPWS respectively GPWS computer defect
- False glide slope indication (centred!).

The GPWS was thus unable to give a warning.

1.16.1.7 Distance Measuring Equipment (DME)

1.16.1.7.1 Description of the DME

ALITALIA DC-9-32s are fitted with two DME interrogators. The distances are displayed on both the PIC's and the COPI's HSI, which means that for each pilot two independent DME readings are available. The frequency selection is independent of the position of the RADIO switch on the flight director control panel. DME 1 depends on the NAV 1 selector and DME 2 on NAV 2 selector.
1.16.1.7.2 Examination of the DME

The PIC's HSI was recovered in a state which permitted examination. The DME indicators on the HSI showed unrealistic values which could be attributed to the fact that they were in the "search mode" at the time of the accident.

This assumption was confirmed by the test flight of 20th March 1991 (FOCA) on which the DME indications were lost at about 7 NM IKL. As it followed the flight profile of the AZ 404 the helicopter entered a reception 'shadow' due to the Stadlerberg. According to the CVR, realistic DME values were noted. We can conclude from this that until this shaded area at about 7 NM, the DME's were working normally.

DME 1 showed the selected frequency of the DME-ILS 14 (108.3 MHz) and DME 2 that of DME-KLO VOR (116.4 MHz).

1.16.1.8 Autopilot

1.16.1.8.1 Description of the Autopilot

The DC-9-32 of ALITALIA is equipped with an SPERRY SP-50A autopilot. This autopilot enables the pilots to lead the aircraft automatically to the GP and the LOC beam and to remain on these beams.

It appears from the DFDR trace that, in all probability, the aircraft captured and tracked the localiser beam with the autopilot. It is assumed that the NAV selector on the autopilot control panel was placed in the position ILS shortly before reaching the LOC beam.

In the normal case, in this position, the aircraft will continue in the same pitch mode ("Altitude Hold", "Vertical Speed", "IAS Hold"). Shortly before reaching the GP beam, the autopilot will command the aircraft to descend with a rate of descent of 700 ft/min for ten seconds and thereafter to follow the GS beam.

1.16.1.8.2 Examination

On the accident flight, on switching the NAV selector on the autopilot control panel, the aircraft was immediately commanded into a descent with a rate of 700 ft/min. It can therefore be assumed that the autopilot received an almost centred signal from NAV receiver 1.

An analysis of the autopilot function and the flight profile shows that the autopilot was most probably following a centred "frozen" GP signal.

A reconstruction of the flight conducted by ALITALIA showed that with the same fault, the profile was identical to that of the accident flight.
1.16.1.9 Examination of Passengers’ Portable Telephones (NATEL = Portable Equipment)

As there were 15 passengers with Swiss residence on board, investigation was made into the possible use of NATEL-C units by one of the victims during the approach.

The use of NATEL units in aircraft has been prohibited by the PTT; this point is made in every subscriber’s "conditions of use" document.

The reason for this prohibition lies in the problems associated with the single channel operating system (range), and also to eliminate the risk of interference with electronic equipment on board the aircraft.

Due to technical reasons, the mobile telephone system used in Switzerland can only be used in Scandinavian countries and not in those bordering Switzerland. Thus the investigation concentrated on the Swiss owners of mobile telephones.

This investigation was undertaken by the Zürich Kantonspolizei. It showed that ten passengers were in possession of NATEL-C units. Seven of these units were still in service after the accident. Two further units were found in victims’ cars. The last of the ten NATEL-C units was used again on 21st December 1990.

A check of the wreckage recovered from the accident site gave no indications that a NATEL-C unit could have been on board DC-9-32 I-ATJA.

As a result of these investigations therefore, it was clear that no NATEL-C units had been taken on board the accident DC-9-32 by those victims who had been resident in Switzerland.

1.16.1.10 There were no clues which could be traced back to the presence of other portable electronic devices except for an electronic calculator.

1.16.1.11 Summary

1.16.1.11.1 Evidence

The evidence supporting a technical fault in the GP deviation circuit in NAV 1 is:

- It is inferred from the cockpit conversation that the crew had set the RADIO switch to the RADIO 1 position (NAV 1). ALITALIA requires the APP position.
- The examination of the NAV switching unit (Point 8) shows clearly that this was in position RADIO 1.
- The impressions on the side of the GS scale in HSI 1 just above the centre mark originate from the GP needle and were caused by the acceleration forces during the collision process.
1.16.1.11.2 Clues

Clues which support that a technical malfunction in the GP deviation circuit of NAV 1 existed:

- The behaviour of the autopilot during the approach
- The behaviour of the GPWS
- The normal functioning of the ILS transmitter for runway 14 at ZRH
- The fact that even before this accident, similar problems had existed on other aircraft. (centred "frozen" deviation indications) (according to communications from the aircraft manufacturer)

1.16.2 Altimeter

The altimeters installed in the aircraft were of the "drum pointer" type. On these the height is presented in thousand foot steps on a drum. For the details of the height above or below the particular thousand foot point a needle points on a round scale. The 'hundred' steps are numbered 1 - 9, each 20 ft step is marked by a small line.

On the drum pointer altimeter, two steps are required to read the height as part of the information is on the drum, and part on the round scale.

Only small parts of one of these altimeters were found in the wreckage. The degree of destruction was so great that no readings and no further examination was possible.

1.16.3 Reconstruction of the Flight

On the accident flight, in the region of 16 - 14 NM (ILS/DME RWY 14) about 1 - 2 NM west of the ILS centreline, at an altitude between 4800 and 4500 fr AMSL, problems occurred with the Glide Path indication. On the 9th March 1991, in order to check the reception and indication of the Glide Path signal with the same environmental conditions, a line flight (LIN to ZRH AZ 404) using an ALITALIA DC-9-32 followed the same flight path as that of the accident flight down to an altitude of 4000 ft QNH. It was possible to confirm that during the whole flight, until interception of the Glide Path, the GP indicator needles on all four indicators were always in the upper limit (out of sight) position. After tuning the VHF-NAV receiver to the ILS frequency at a distance of 17 NM (ILS/DME), the GP or LOC "flags" never appeared.
To obtain data about the reception quality of the Glide Path signal and the ILS DME throughout the Approach profile, two helicopter flights were conducted on 20th March 1991. The first flight during daylight, the second at night. The helicopter whilst flying on the LOC (RWY 14), followed the vertical profile from 14 NM (ILS/DME) until the point of impact. In addition to the two aircraft receivers, a GP signal strength measuring unit was used. During both flights the following observations were made:

<table>
<thead>
<tr>
<th>LOC centred</th>
<th>NO FLAG</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP (Left) Full Fly UP</td>
<td>NO FLAG</td>
</tr>
<tr>
<td>GP (Right) Full Fly UP</td>
<td>FLAG at 6.5 NM ILS/DME</td>
</tr>
<tr>
<td>DME</td>
<td>FLAG at 6.5 NM ILS/DME</td>
</tr>
</tbody>
</table>

Additional observations at night:

During the approach, the runway was visible until a distance of 7 NM ILS/DME. The Stadlerberg seemed to be a "Black Hole".

Using the BRITISH MIDLAND/FLYTSIM DC-9-32 simulator at High Wycombe GB, the technical and operational implications of a scenario caused by a false GP indication from NAV-1 were noted. The simulator was modified to create an "open circuit" in VHF NAV-1, and thus a centred GP indication without a GP FLAG. The ALITALIA DC-9-32 simulator in Rome, which is identical to the accident aircraft, was modified in the same way. The sequence and correlations together with the resultant observations are noted in the analysis (2.3.1).

1.17  Miscellaneous

1.17.1  Air Traffic Control

1.17.1.1  Personnel Organisation of the affected ATC Shift

Personnel on Duty at the time of the accident in TWR/APP

<table>
<thead>
<tr>
<th>Personnel</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerodrome Control</td>
<td>ADC -</td>
</tr>
<tr>
<td>Ground Control GRO, Supervisor</td>
<td>DL -</td>
</tr>
<tr>
<td>Clearance Delivery</td>
<td>CLD -</td>
</tr>
<tr>
<td>Communications</td>
<td>COM -</td>
</tr>
<tr>
<td>Coordinator Approach</td>
<td>CAP -</td>
</tr>
<tr>
<td>Approach Control (West Sector)</td>
<td>APW -</td>
</tr>
<tr>
<td>Approach Control (East Sector)</td>
<td>APE -</td>
</tr>
<tr>
<td>Departure Control</td>
<td>DEP -</td>
</tr>
</tbody>
</table>

1 person
1 person
2 persons
1 person
unmanned
1 person
unmanned
1 person
Allocation of Workstations

The workstations were allocated according to a shift plan. As a result of the reducing level of traffic, at about 1909 Hrs the CAP and DEP stations were closed as usual. The controller (ATCO) who had been relieved from the APP station was in the TWR available for further duty.

The AZ 404 was handled by APP west. The duty controller had the following duty and rest times:

- Shift began at 1500 lt 14th November 1990
- Between 13th November and 14th November 1990 the rest period was adhered to. On the 14th November there was no alcohol intake or use of medication.

Just before the accident the ATCO was handling 6 aircraft simultaneously. According to statements from colleagues, handling 6 to 8 aircraft an ATCO is not overloaded and this represents a normally high workload. Another ATCO stated that 6 aircraft was a normal high workload but the limit is reached with 10 to 12 aircraft.

1.17.1.2 Applicable Instructions for the Air Traffic Controller

The applicable instructions are mainly in the Manual of Air Traffic Control (Zürich) which is based on the relevant ICAO procedures.

1.17.2 ALITALIA Flight Procedures

These are to be found in the ALITALIA DC-9-32 Operating Manual and the ALITALIA Flight Operations Rules and the ALITALIA Company Manual.

1.17.3 Approach Charts

The ILS approach to runway 14 at Zürich is published in the AIP Switzerland. The approach chart published by the FOCA and current at the time of the accident is at annex 10 of this report. The approach chart from the ALITALIA Route Manual used by the crew can be found at annex 11, such a chart was used by the pilots. By comparing the two charts, it can be seen that, on the ALITALIA charts there is no relief shown beneath the final approach contrary to the AIP chart.

1.17.4 Recommendations of the Interim Report and the Reactions of the Responsible Authorities

In accordance with article 24 paragraph 2 of the Federal Council’s Ordinance for Air Accident Investigation of 20th August 1980, on the 19th December 1990 the Investigator in Charge established some recommendations and immediate measures by means of an interim report, which was sent to the FOCA in Berne, and to the Italian Ministry of Transport (Ufficio Sicurezza Volo) in Rome.
The Recommendations to the Italian Authorities were:

1. The ALITALIA Company Operating Manual should be expanded in the following sense:

1.1 Should it not be possible to fly an ILS approach in the normal APP mode, and it has to be flown in NAV 1 or NAV 2, this is only allowed after checking position and altitude. In such a case, cross checks must be carried out by the crew at regular intervals as on a LOC approach.

1.2 The flight director pitch bar must not be centred manually.

1.3 After a call "GO AROUND" the respective measures should follow immediately, irrespective of who (the PIC or the Copilot) called for it. A GO AROUND, once started will be completed and not interrupted. (= 04.20.8 Operating Manual).

1.4 A simulated CAT II approach should be defined in the sense that a genuine CAT II approach should be executed.

2. It should be evaluated whether by issuing a personal route manual to each pilot, this would lead to a better flight preparation (home study).

3. The pilots should always have the approach chart in their direct field of view (perhaps a smaller format).

4. The approach charts in the ALITALIA Route Manual should have appropriate terrain section profiles under the glide paths (compare approach chart ILS 14 Zürich AIP Switzerland).

The Italian Ufficio Sicurezza Volo issued the following safety recommendations to the Italian Airlines on 15th January 1991 (Translation from Italian):

SAFETY ADVICES

1. The airline operations documentation shall contain the following information clearly:

1.1 When an ILS procedure is being conducted on any aircraft type using a single VHF NAV receiver, it is mandatory to maintain a continuous check of the correct vertical and horizontal position. This check is mandatory for aircraft which have a Flight Director system with the possibility to switch to RADIO 1 or RADIO 2 enabling the ILS presentation to be fed from a single receiver.
1.2 Whilst conducting a flight, if a situation arises which should be stopped and in the sense of "crew integration and communication" communication between the two pilots is lacking, the required corrective action should be executed by the pilots immediately. The one who recognised the situation must be supported until the completion of the manoeuvre. Above all if such a situation occurs during a final approach, the Go Around must be executed instantly and the PNF must give the maximum support so that the manoeuvre can be completed correctly.

2. The airline shall mention the following in documentation and during training:

2.1 The Briefing for an approach must be short and concise; it should however contain, bearing in mind the aircraft configuration and the approach procedures, minimum altitudes at defined positions with their correct identification, the DH (Decision Height) or the MDH (Minimum Decision Height) connected with the approach procedure. The discussion of items which are not directly connected with the above should be avoided, for the sake of control of the flight, and the correct execution during the approach and landing phases only the initial points of the possible Go around should be mentioned.

2.2 All possible available information must be used to gain a complete picture of the accuracy of the actual position.

1.17.4.2 Recommendations to the Swiss Authorities

1. The Manual of ATC (Switzerland) should be expanded in the sense that the Approach Controller should monitor the altitude (as long as an appropriate SSR signal is visible on the radar screen) until the crew has called established. If needed be the crew must be requested to make this call.

2. All ILS runways in Switzerland should be equipped with a PAPI system. ICAO recommends VASI or PAPI for all ILS RWYs. Various states including Switzerland have exempted ILS RWYs and have notified ICAO accordingly.

3. The erection of an obstacle lighting system on the Stadlerberg should be evaluated immediately. According to current ICAO standards, the natural obstacles beneath an ILS need only be lighted to a distance of 3 km from the RWY threshold. The distance of the Stadlerberg from the threshold RWY 14 is 9.3 km.

The reaction of the Federal Office for Civil Aviation (FOCA):

to 1. On the 20 December 1990 the FOCA gave the instruction to SWISSCONTROL that the recommendations being an immediate and interim measure should be followed immediately. Swisscontrol actioned this instruction with an amendment to the Manual of ATC valid from 22nd December 1990. The relevant Swisscontrol operating instructions were adjusted on the 5th February 1991 and are still in force at the completion of the investigation.
to 2. Installation of PAPI on all Swiss ILS runways will be evaluated.

to 3. Steps have been taken to obtain obstacle lighting for the Stadlerberg.

1.17.5

Recommendations from the US NTSB to the FAA

In January 1992 the officials responsible for accident investigation in the USA, the National Transportation Safety Board (NTSB), issued the following Safety Recommendations to the Federal Aviation Administration (FAA) for publication. The recommendations are:

'Issue an Air Carrier Operations Bulletin to Principle Operations Inspectors requiring that operators of airplanes equipped with the following navigation receivers include in their operating manuals procedures for detecting malfunctions that result in the display of disparate information: Collins model 51RV-1; Collins model 51RV-4; Wilcox model 806; King model KNR 6030; and some versions of Bendix model RNA 26C. Also notify formally foreign airworthiness authorities about the potential failure mode in such equipment'. (For full text see Annex 12)

The NTSB recommended to the FAA that pilot handbooks of those airlines which use NAV receivers of the models specified should included an appropriate warning, and that the foreign (non American) aviation authorities should be informed. ALITALIA have already amended their books accordingly and thus have already complied with this American recommendation (see Annex 15).

1.17.6

Go Around Procedure

According to calculations from the investigating team and from the manufacturers, the go around started by the Copilot 19 seconds before the accident would have been successful had it not been interrupted (Annex 14).

2.

ANALYSIS

2.1

The Ground Equipment

2.1.1

The Instrument Landing System of Runway 14

This was used by other aircraft prior to and after the accident without any irregularities being noted. The calibration flight conducted by the FOCA calibration aircraft a few hours after the accident, confirmed that the ILS equipment was functioning normally. It can therefore be assumed that at the time of the accident, the ILS 14 (CAT III) was functioning normally.

2.1.2

Obstruction Lighting on the Stadlerberg

The Stadlerberg is too far from the runway threshold for it to require obstruction lighting, as specified by the ICAO standards. As the 637 m high Stadlerberg can not be seen at night due to its unlit surroundings, it could thus become a danger to aircraft unintentionally flying below the glide. The subject of obstacle lighting has
been in discussion between Swissair, the airport authorities and the FOCA since 1976. Supported by the recommendations in the intermediate report to the authorities of the 19th December 1990, this lighting will now be erected.

It is not to say that the crew of the accident aircraft would have noticed such lighting. It gives no indication on the CVR recording that one of the pilots looked outside before the accident. It is more likely that in accordance with normal procedures and from the CVR conversations that their attention was concentrated fully on the instruments. Additionally, the Stadlerberg was capped with a cloud layer of unknown thickness.

2.1.3 Angle of Approach Lighting

Contrary to the ICAO standards, Switzerland and other countries do not equip ILS runways with Angle of Approach Lighting (VASI or the more accurate and modern PAPI). Switzerland has made ICAO aware of the difference.

As an angle of approach lighting system could have been of assistance in the event of an error in navigation and with visual conditions, the installation of a PAPI system is now being evaluated for Swiss ILS-runways.

2.2 The Aircraft

2.2.1 An explosion on board the aircraft during the approach could be excluded soon after the accident. There were no such clues. The radar recordings clearly showed that the aircraft had already descended below the correct altitude.

2.2.2 The examination of the engines after the accident and the recordings from the flight data recorder excluded any engine damage. These were working correctly throughout the flight.

2.2.3 The recordings from the CVR show that the instruments (ADI/HSI) had apparently captured the glide slope and at a moment when the aircraft was flying about 1300 ft below the glide path. Special emphasis was placed on the examination of the NAV instruments and the NAV receivers. In respect of the indications, only a part of the Captain's HSI unit was found. With the help of microscopic examination, it could be determined that during the impact, the glide path indicator had been positioned just above the centre "On Glide" position.

Securing of evidence, examination, and evaluation of the CVR confirmed that all 4 NAV indicating instruments followed the glide path during the final approach, although the aircraft was flying under the nominal glide path of RWY 14.

NAV receiver 1, onto which all 4 NAV instruments were switched during the final approach, could be recovered and examined. No pre-crash defects were found either on the unit, or on the plug in question. Admittedly after the accident, it was found in a heavily damaged and deformed state.
The detailed examination of the NAV equipment and the letter dated 24th August 1984, which related to the NAV Switching Failure Mode, passed to the Investigator in Charge by the aircraft manufacturer McDonnell-Douglas, shows that the use of the NAV mode can lead to a completely false LOC or GS indication ('ON' indication) without any warning appearing in the instrument (red flag). This happens when the NAV receiver does not deliver an output signal. The letter from the Douglas Aircraft Company went to all operators of DC-8, DC-9, C-9 and MD-80 aircraft and showed the doubtful NAV receiver types in which the failure could occur. ALITALIA received the letter and the accident aircraft was equipped with the receivers in question.

Although the Douglas Aircraft Company held a seminar for the affected companies during 1985 in Long Beach, USA, at which ALITALIA was represented by three Captains, the message from both the letter and the seminar was not transmitted to the ALITALIA operating crews. They, including the affected crew, were unaware of the possible false indications in question. After the accident, ALITALIA informed all the pilots about the problem and such failures have been included in the training and refresher programmes in the simulator. The US NTSB, who were only made aware of these false indications by this accident, have reacted in the meantime and made the necessary recommendations to the FAA.

Both altimeters were of the so-called, "Drum Pointer" type. These older models have the disadvantage that the altitude can only be read in two steps, because the main information is shown on the drum, and the refinements by a pointer on the round scale. A further complication is the fact that in certain pointer positions, the drum is not possible to read adequately as the numbers on the drum are partially obscured by the pointer. Despite the white band which appears on the left side of the "thousands" figures, this can lead to an incorrect interpretation of the "thousands" value.

The critical part of the flight is the landing phase. Although this is only about 4% of the whole flight time, 48.3% of accidents occur during the approach. In past years, there were several accidents which could be traced back to misreading the altimeters.

Amongst other studies, NASA has published the following which are concerned with the problem of Altimeter Misreading:

- NASA TM-81967 "How a Pilot looks at Altitude".
- NASA TP-2525 "Analytical Techniques of Pilot Scanning Behaviour and their Application".
- NASA TM-86424 "Effects of Digital Altimetry on Pilot Workload".
- NASA TP-1250 "Airline Pilot Scan Patterns during Simulated ILS Approaches".
Summarising these studies, we can say the following:

1. Mis-reading of "Drum Pointer" altimeters occurs often.

2. Several glances at the altimeter scale are necessary to assimilate all the information that is available.

3. The pilot can recognise the relative needle position (left/right) with a short glance (0.1 sec).

4. Reading the drum (thousand indication) requires 0.6 sec. and is more difficult than reading a needle. As a result, the drum is consulted less frequently.

5. During an approach, the altimeter is consulted during about 3-6% of the time. The NASA studies showed that the pilots surveyed thought that they had monitored the altimeter during 20-25% of the approach.

From a survey of 169 US National Airlines B-727 pilots (NASA TM-81967):

- 137 pilots said that they had already mis-read an altimeter.
- 134 pilots had observed another pilot mis-reading an altimeter.
- 85% of both groups explained that they had made these observations more than once.
- A surprisingly high amount of mis-reading (50) occurred during the approach phase.

The survey led to the following additional comments from the pilots:

- "This altimeter takes more concentration than should be necessary to read accurately."

- "The small drum window is a complication on the instrument and (is) quite small, often requiring a 'double look' and diverting attention from the needle. Other instruments require only a single point of visual attention to comprehend and do not divert, slow or complicate a smoothly flowing scan."

- "Misreads always seemed to occur at the lower altitude when attention is split between more activities."

- "The more stressful situations produced more misreads."

- "A quick look after (being distracted) can usually induce a reading of 1000 ft off if the barrel drum is half way between thousands."
Much earlier it was noted that the Drum Pointer Altimeter design was problematic. The following statements support this:

1959 USAF Report Training Research & Development Section "Evaluation of the Drum Pointer Type MD-1 Altimeter"

"The Drum Pointer Altimeter is not an acceptable instrument. When using the drum presentation, pilots can be expected to overshoot altitudes due to non-interception of the 1000 foot increment".

1959 USAF Flight Test Report, "Re-evaluation of Drum Pointer Altimeter Display"

"The drum pointer altimeter, in the configuration and the presentation tested, was found to be inferior to the three pointer altimeter and unacceptable for general Air Force use. It admittedly does away with the 10,000 ft reading error, especially at low altitudes. The disadvantages of the instrument outweigh the advantages by a wide margin".


"The basic instrument design, coupling the indicator types of drum and pointer circular scale has been shown empirically to elicit relatively high percentages of 100 ft and 1000 ft quantitative reading errors".


"The possibility of over-reading the particular type of altimeter (drum pointer) by 1000 ft, has been clearly established and it is possible to easily imagine circumstances in which such misreading could lead to an accident".

1972 Mitre Corp. "Altimeter Display Study"

"An advisory circular should be issued, suggesting that all aircraft replace 3P (3 pointer) and DP (drum pointer) altimeters where feasible to enhance flight safety".


"Remove all altimeters (drum pointer) from B-727 fleet and change to digital read-out type. The digital read-out altimeter is very difficult to misread below 1000 ft".

"If you think such altimeter misreads are uncommon, be forewarned. Some available evidence suggests misreads are uncomfortably common with this drum pointer. The current trend indicates another drum pointer related accident will occur in 1980 or 1981".

It should not be excluded that one or more altimeter reading errors contributed to the AZ 404 accident. It is plausible that the PIC had read a height below 1000 ft as a height above 1000 ft. As he was convinced that the Outer Marker height of 1250 ft had only been undershot by a small amount, he intervened during the Copilot's "Go Around" order. He prevented the missed approach in the belief, that with a reduced rate of descent or even a short level flight segment, the nominal glidepath could be attained within a short time. For technical reasons a GPWS warning was not possible at this point.

It is not known why:

- The aircraft manufacturer did not release any recommendations
- The national authorities did not produce any directives (Manufacture and Registry states)
- The company made no efforts to have the altimeters in question replaced.

2.2.5 During the approach, the crew had their indicating instruments (HSI and ADI) switched to NAV receiver 1 (RADIO 1). As a result an important safety system was bypassed and its optical warning was not available. It is doubtful whether the available switching capacity of the NSU is adequate for flight safety.

2.3 Flight Sequence

At 1836 hrs flight AZ 404 took off from runway 36R at LIN bound for ZRH. The climb towards CANNE was normal. Noteworthy is that during the cruise, although the pilots knew that the actual wind was relatively weak (actual 240/8 kt, TAF maximum 10 kt), unusually long discussions ensued about circling to runway 28 in ZRH. The most recent ATIS information (Germany) gave Runway 14 as the actual landing runway. Questioning the COPI about the radio failure procedures during the descent was unusual. Errors developed during the confirmation of the CAT II minimum and the Go Around procedures, and the COPI had the wrong landing chart in front of him. The instructional tone used by the PIC to the COPI on many occasions was noteworthy. Although a CAT II approach was to be conducted, nothing is heard about the procedure.
Based on the CVR recording, the last 10 minutes of the flight can be shown as follows:

19.01.30: The aircraft was abeam (South West) Kloten (KLO VOR) at FL 90. The PIC drew the COPI's attention to the position with the comment they were rather high. The PIC recommended emphatically that the COPI should reduce the speed further with the reasoning that from now on they would only move further away from the airport and that the aim was to make an economic approach. A little later (19.02.07 hrs) the flight was instructed by ZRH APP to reduce the speed further to 210 kt which was accompanied by the PIC's remark "You see!"

19.04.32: The PIC defined the outer marker height as being 1200 ft, (correct would have been 1248 ft QFE) and gave the distance as 3.8 NM KLO-DME (correct would have been 3.8 NM ILS-DME).

19.06.20: The crew received the following clearance: "AZ 404 descend to 4000, turn right HDG 110, cleared ILS approach runway 14, QNH 1019." This clearance was read back by the PIC only incompletely and the HDG was read back as 120 instead of 110. In addition, the flight number and the confirmation of the approach clearance were missing from the readback. The Air Traffic Controller did not correct the wrong readback of the HDG. The flying pilot turned according to the clearance onto HDG 110.

Visualisation of Cockpit Indications (Annex 13)

19.06.45: Figure 1: Starting point RADIO 1
Figure 2: Starting point RADIO 2
Both versions are possible.

Having received the approach clearance and approval to descend to 4000 ft QNH the altimeters were correctly set as follows (see 1.18.5 ALITALIA Company Manual, Altimeter setting): PIC's side QFE 970 hPa, COPI's side QNH 1019 hPa; Altitude Preselect 1019 mb/4000 ft.

Fig. 1: In the Radio Selector position 1 the relative position to the localiser (LOC) and glidepath (GP) is shown on all four instruments (ADI 1 and 2, HSI 1 and 2), supplied by VHF- NAV 1 (108.30 MHz/ILS 14).

Assuming that the fault in the GP receiver already existed, the GP indicator on all four instruments was centred. As the crew were of the opinion that they were above or at least on the glidepath, the indication was plausible for them.
Fig. 2: The Radio Selector was on RADIO 2. All four instruments showed the position relative to the misleading course 138 on KLO-VOR (VHF-NAV 2).

19.07.25: Fig. 3: The crew selected RADIO APP on the Radio Selector. By switching to RADIO APP, VHF-NAV 2 internally automatically tuned the ILS frequency 108.30 MHz of VHF-NAV 1. The selected frequency of 116.40 MHz on VHF-NAV 2 remained visible and available for DME 2 receiver. Accordingly, DME 2 showed the distance to KLO-DME. DME 1 showed the value from ILS-DME 14. The signal from VHF-NAV 1 receiver was displayed on HSI 1. Due to the fault in the GP receiver 1 a Null (zero) Signal was sent which led to an apparently correct centred GP indication on HSI 1. ADI 2 takes the LOC and GP information of HSI 1. HSI 2 received information from VHF-NAV 2 receiver which was functioning correctly. ADI 1 received the LOC and GP information of HSI 2. The actual position was way below the nominal glidepath. Accordingly the pointers in HSI 2 and ADI 1 were in the upper limit position and as designed not in view. The OFF FLAG was not in view because the GP signal was being received.

19.07.40: Fig. 4: In the meantime, the Flight Director Mode Selector was switched to the position NORM, confirmed by "N-L ARM" in the Mode Annunciator Panel. Due to the disparity of the GP indications, the GP Comparator warning light came on. The Copilot (FP) asked: "Do you have the Glide?". The Captain replied "On 1...". Five seconds later the Copilot said: "I don't have it". The Captain’s comment "On 1" referred to the indication on HSI 1 which was centred. The Copilot, with the words "I don't have it" was referring to the indication on HSI 2.

19.08.00: Fig. 5: At 19.07.59 hrs the PIC decided: "Good, let's do it on 1", whereby the COPI ordered "RADIO 1".

On switching to RADIO 1, all four instruments switched to VHF-NAV 1. The crew had a centred GP indication on all four instruments. This presentation corresponded with the pilots' idea of their position and altitude. At this point the altitude was still about 4600 ft QNH. On approaching the LOC the autopilot NAV Selector was turned to ILS. As designed, the autopilot captured the GP ("GP-CAP" in view on the AP Mode Annunciator). This event is documented by the change in Rate of Descent from about 1150 ft/min. to about 700 ft/min.
19.08.47: Fig. 6: The aircraft was slightly East of the LOC at about 4000 ft QNH where, although both Flight Directors and the Autopilot were following the LOC and GP. In the case of the GP it was the Null Signal from VHF-NAV 1 receiver. Here the aircraft was already 1200 ft below the nominal glidepath and still 12 NM from touchdown. This finding is supported because at 19.08.47 hrs the PIC confirmed "... capture LOC capture Glide path capture, so we are on the beam a little off track but ...".

19.08.53: Fig. 7: Descent through 4000 ft is confirmed by the COPI "970 for me too", as he also set his altimeter to 970 hPa QFE.

19.08.57: Fig. 8: The aircraft passed 3700 ft as the Altitude Exit Warning sounded. This was armed to the selected altitude of 4000 ft QNH on the Altitude Preselect System.

19.09.43: Fig. 9: Convinced that he was established on the ILS, the PIC said at 19.09.09 hrs: "I cancel and set 5000", referring to Altitude Preselect System. At this point the Landing Gear was probably extended, as during setting of the Flaps to 25 (19.09.41 hrs) no Gear Warning Horn was heard. At 19.09.18 hrs the PIC urged the COPI to reduce the speed further as he feared they were closing too near to the preceding aircraft. At 19.09.47 hrs the PIC stated "The outer marker check is at 1250 ft (QFE)". The altitude was now 1600 ft QFE and the distance from touchdown about 9 NM. As before, the aircraft was about 1200 ft below the the nominal GP.

19.10.12: Fig. 10: At 8 NM IKL, the altitude on the GP should have been 4000 ft/QNH or 2598 ft/QFE. As the PIC remarked "3.8 almost 4 miles", the actual height was 1100 ft/QFE (outer marker height 1248 ft/QFE). These distance figures referred to the ILS-DME distance to the Outer Marker. At 19.10.27 hrs the COPI asked whether they had already passed the Outer Marker. At 19.10.39 hrs he repeated this question once again. The PIC responded "No, no, it hasn't changed yet ...." It is not clear what this answer meant.

19.10.43: Fig 11: The PIC remarked that the ILS-DME showed 7 NM and possibly began an analysis of the position. His thoughts were interrupted by the order from ZRH APP to change to ZRH TWR on frequency 118,10 MHz. The instruction to change frequency with an indication of the relative position to the preflying airplane and the clearance that there were no more speed restrictions did not give the crew any reason to analyse their position. At 19.10.56 hrs the Captain's uncertainty was heard "That doesn't make sense to me ...", the COPI responded "... nor to me ...".
19.10.59: Fig. 12: At 19.10.57 hrs the PIC called out "Pull, pull, pull, pull" upon which disconnection of the Autopilot is heard. The PIC, due to misreading the altimeter, was obviously of the opinion that they were still at 1300 ft/QFE. Possibly the PIC wanted the COPI to fly the aircraft level until they reached the Outer Marker. The COPI probably interpreted the altimeter correctly and read a height of 300 ft/QFE. This caused him to commence a missed approach with the order "Go Around" (position about 6 NM from touchdown).

19.11.17: Fig 13: At 19.10.59 hrs, the beginning of the Go Around manoeuvre is clearly recognisable. Immediately (19.11.00 hrs) after the COPI's "Go Around" order the PIC intervened as follows: "No, no, no, no ... catch glide". Italian expression "fattiti" (phonetic).

2.3.1 Crew

2.3.1.1 Human Relationship in the Cockpit

The human relationship situation in the cockpit can only be judged on the basis of the CVR. Unfortunately due to the open speakers and possibly to a worn out tape, the quality of this tape recording is very bad.

The psychological interpretation of the sound levels in respect of the feelings and atmosphere is particularly difficult. It can certainly be stated that during the entire flight the conversation restricted itself to operational matters. The PIC thus showed his experience based superiority.

2.3.1.2 Use of the ALITALIA Procedures and Deviations from Trained Procedures

From the evidence, there is no strict adherence to the ALITALIA procedures. Had the crew stuck to the procedures, the void between the PIC and the COPI, i.e. the coordination and cooperation, would probably have been covered at least in the critical phases. Extracts from the ALITALIA Company Manual (04.20.4/4):

- Approach briefing
- Initial Approach Altitude
- MSA (briefing)
- Standard Operative Call-Outs "LOC alive", "Glide alive" (04.20. 7/2)
- Conditions requiring a missed approach (04.20. 8/2).
2.3.1.3 Airmanship (Professional Competence)

a) Crew

In general, it appears that during the flight the PIC's behaviour was professional during routine operations. The impression does not apply when abnormal conditions appeared. In switching the Radio selector to RADIO 1, the crew did not proceed to an analysis of the cause of the (supposed) false indication, or even to make a subsequent crosscheck. It appears to have acted on a predetermined opinion (expected indication regarding the GP). The COPI continued the descent below the outer marker altitude although this had not been passed.

b) Crew as team

The team work in the critical phases was incomplete.

2.3.1.4 Navigation Monitoring during Radar Vectoring

Flight AZ 404 received clearance from APP to descend to 4000 ft/QNH with a subsequent ILS approach. AZ 404 was only given a distance to the preflying airplane, but it was never given a distance to the touchdown of RWY 14. Similarly, the CVR contains no conversations between the pilots concerning verification of position, until the point (ca. 40 seconds before impact) when the pilots compared the indicated DME distance (7 NM) with the Outer Marker distance of 3.8 NM which led to uncertainty. It appears that from the beginning of the approach, the crew had exclusively followed the instructions of the APP controller. The ILS localiser intercept, reaching 4000 ft/QNH and the false GP indication (NAV 1) occurring simultaneously could have led the crew to believe that this was a result of an optimum radar vectoring. In addition, the "assumed" establishing on the ILS required no further navigational analysis. Had the crew verified the DME distance on leaving the Initial Approach Altitude of 4000 ft, then they would have noticed the discrepancy between the actual position at 14 NMs and the correct distance for this (Approach Fix) of 8 NM. Neither before nor during the approach did the crew carry out a timely systematic check of the indications of both NAV equipments. Additionally had these indications been compared with other available aids it would also have occurred to them that the GP indication on NAV 1 could be wrong.

Factors from the predominantly dynamic environment could have led to inadequate monitoring of the navigation. The CVR shows that as several aircraft were on approach, there was intensive ATC radio traffic (APP) with the correspondingly high concentration and attention required of the pilots. In addition, the PIC's concern that the aircraft was closing on the preceding one too rapidly, thus risking a Go Around, further limited capacity.
2.3.1.5 Go-Around

The Flight Operation Rules of ALITALIA (04.20.8/2) contain amongst others, the instruction that during an IMC instrument approach a Go-Around shall be flown if there is any doubt about the functioning of available navigation aids.

About 40 seconds before the impact, the COPI asked whether the outer marker had been overflown, the PIC said that it had not. Immediately afterwards, the PIC noted that the distance was 7 NM ILS-DME. The resultant uncertainty is audible on the CVR. Even if one had misread the altimeter by 1000 ft too high this would still have suggested a Go-Around. The COPI as flying pilot executed one which was not accepted by the PIC. Even the Radio Altimeter warning which sounded ten seconds later caused no reaction.

Two independent studies have shown that had a Go-Around been continued, the Stadlerberg would have been cleared albeit very close (Annex 14).

General experience shows that a considerable resistance to Go-Arounds exists amongst pilots. The main reasons for this are the subsequent need for filling in reports, the time loss as well as the unpleasant duty to inform the passengers and cabin crew. A Go-Around is seen as a failure, as lack of professional competence and even loss of prestige. Before the critical situation, the PIC had already mentioned a possible Go-Around due to the proximity of the preceding aircraft and wanted to avoid this. His pointed self-confident manner towards the COPI, in addition to an internal resistance, did not make it easier for him to accept a Go-Around. He was apparently not aware of the danger of the situation.

According to ALITALIA their crews do not have to justify such situations.

2.3.1.6 Headsets and Microphones

The quality of the CVR recording is bad. It required a great deal of work to understand the cockpit conversations recorded from the area microphone. The reasons for this bad comprehension is due on the one hand to the inferior technical quality of the recording equipment but in particular it is due to the fact that the pilots, even during the approach, did not make use of the headsets (with attached microphone) for communications with the approach controller as is usual. The conversations between the pilots are therefore partly obscured by external radio traffic.
2.3.1.7 Medical Aspects

There are no indications of any medical causes for the accident based on previous medical history, as far as it is available, personal contacts, the flight progress, the CVR and the findings of the Post Mortem.

Various levels of Ethyl Alcohol concentration between 0.02 0.00 and 0.38 0.00 were found in the Copilot's tissue. Such differences do not occur with samples taken soon after death, and are attributable to changes in the alcohol content after death. The samples were heavily infested with 12 types of bacteria. 11 of these types produce ethylalcohol and 1 reduces it in very small amounts. The effects of intense heat can also vaporise alcohol.

Even on the basis of toxicological analysis, it can not definitely be excluded that the pilot consumed alcohol before death. The effects of an alcohol level of 0.3 0.00 on the capabilities is given different values by various authors: it is certainly not very great. Based on the observations of personal contacts and from the Cockpit Voice Recorder there is no evidence to support that the Copilot was in an inebriated state. Generally it is probable that this is related to alcohol produced after death.

2.4 Air Traffic Control

2.4.1 The radio-electronic approach aids - ILS 14 - were, according to the automatic monitoring systems, functioning normally. This fact was confirmed by subsequent calibration test flights. Test flights checked the LOC, GP, DME and the marker transmitters. The approach and runway lighting was switched on and operating normally. The communications and radar equipment was also working correctly.

2.4.2 The necessary Air Traffic Control work-stations were occupied according to the duty roster. The Air Traffic Control management have determined that the level of approach traffic prevailing at the time of the accident was normally so high.

2.4.3 On the beginning of the approach AZ 404 was on radar vectoring on FL 60. In this phase the ATC-Controller is responsible for terrain clearance according the prescriptions.

At 19.05.20 hrs the Approach Controller instructed flight AZ 404 to descend to 4000 ft, turn right onto heading 110 and he gave clearance for an approach on the ILS for runway14 using a QNH of 1019 hPa. This clearance guaranteed terrain clearance until the final approach point (FAP).

As the heading changed to about 150, the ATCO assumed that the AZ 404 had taken up his own navigation and was establishing on the LOC. According to the procedures, the radar vectoring is completed after the "Established" call. This call should be requested by the ATCO and in this case was omitted. The crew did not call on their own initiative.
Under the circumstances, the call established would probably have been made because the crew were under the illusion that they were fully established.

According to the published approach procedure, the aircraft should have left the cleared 4000 ft only when on the ILS, and at a distance of 8 NM ILS-DME. In fact the aircraft descended below the cleared altitude on intercepting the LOC at a distance of about 11.5 NM, flying parallel beneath the GP with a roughly constant rate of descent until the accident site.

Although the altitude transmitted by the aircraft transponder was clearly visible on the Approach Controller’s radar screen, he did not pay attention to it, and did not notice that the aircraft had already left its cleared altitude before the Final Approach Point (8 NM). According to the standing instructions until this point the ATCO must check the adherence to cleared altitudes and in the event of an undershoot he must intervene. He omitted this check as he was of the opinion that his monitoring function was finished, because the aircraft was on the LOC at the instructed speed and he assumed that aircraft was also established. This assumption can be explained because during the whole duty time of an ATCO many aircraft are observed on the LOC beam on the radar screen compared with very rare cases of aircraft being below the cleared altitudes and the glidepath. The failure to call established by the pilots happens from time to time and was generally tolerated by ATC. The constant flow of traffic which in Zürich is occasionally quite dense did not seem to allow a time consuming questioning. In this situation it is expected that an aircraft observed on the LOC will also follow the prescribed approach profile.

Finally it must be noted that the Approach Controller never gave flight AZ 404 position or distance information relative to runway 14. He merely gave a distance to the preceding aircraft.

2.4.4 During the investigation it was noted that the instructions contained in the Manual of ATC volume 1, although conforming with the international standards of ICAO, were presented in a way that does not allow a good overview, and it is sometimes not precisely formulated and thus can lead to varying interpretations. In particular the transition from radar vectoring to pilot interpreted approaches is not precisely formulated. The terrain collision avoidance is not part of the ATC responsibility except during radar vectoring.

It may also be noted here that the SWISSCONTROL instructions exceed those of ICAO in the area of radar monitoring.

2.4.5 In summary it can be stated that the clearances and instructions of ATC contained no incorrect statements. However as a result of omissions by not following the standing instructions the disastrous sequence was not interrupted by ATC.
A timely warning from the Approach Controller and the appropriate action by the crew might possibly have prevented the accident. Particularly with the uncertainty prevailing in the cockpit at the time just before the accident, a warning would have been taken seriously and would have led the crew to a check and make a comparison of the various instruments - above all the altimeters.

A "Minimum Safe Altitude Warning System" on the APP radar, as has been used for the last ten years in the USA, would have automatically made the task of noticing an altitude undershoot possible independent of the traffic density.

From the numerous safety nets in air transport, also the one of the ATC did not prevent the accident.

3. CONCLUSIONS

3.1 Findings

- The aircraft fuselage and engines were in order and working normally during the flight. The weight and centre of gravity were within limits.

- The NAV receiver No 1 which was in use during the approach (Type King KNR 6030) was apparently not delivering an output signal. All 4 NAV indications gave an "On Glide" indication without a warning flag appearing.

- The possibility of such a failure on the NAV equipment in use has been known since 1984.

- ALITALIA was informed by the aircraft manufacturer about the possibility of these failure possibilities in the years 1984 and 1985. They were unknown to the crew of AZ 404.

- The altimeters used in the aircraft were of the so called "Drum Pointer" type. On these, the danger of misreading is particularly great.

- The crew of AZ 404 were in possession of the necessary licences.

- The pilots were in good health. The minimal level of alcohol found in the Copilot's body can most probably be attributed to post mortem micro-biological processes at the accident site.

- The COPI was the flying pilot.

- Before intercepting the ILS 14, the crew switched to RADIO 1 - (NAV No 1).

- The Final Approach Point ILS 14 is situated 8 NM from the runway (ILS-DME) at 4000 ft/QNH.
On intercepting the LOC at 11.5 NM the aircraft descended below the cleared altitude of 4000 ft/QNH.

The aircraft followed the LOC 14 precisely but descended constantly about 1300 ft below the GP until the accident site.

The crew allowed the aircraft to descend below the outer marker height of 1248 ft before passing the outer marker.

During the entire approach, there was no GPWS warning in the cockpit.

The Approach Controller was in possession of the necessary licences.

The approach control work station is equipped with secondary radar including height and ground speed readout.

The Approach Controller did not give the crew of AZ 404 any position or distance information relative to runway 14.

The Approach Controller never noticed the altitude undershoot of the aircraft.

Weather in the accident area: Wind SW/5 - 10, Visibility ~8 km, light rain, Cloud covered - base at different heights, locally at 1800 - 2000 ft AMGL.

Weather on Zürich airport (ATIS 1850): Landing RWY 14, Take off RWY 28, Met report Zürich 1850, 240 degrees 4 kt, Final RWY 14 and 16 250 degrees 7 kt, Lift Off RWY 16 240 degrees 4 kt, visibility 10 km, Mist, 2/8 1500 ft, 5/8 3000 ft, 7/8 4000 ft, temperature 9, dew point 8, QNH 1019, NOSIG, Transition Level 50, Zürich Information ECHO.

According to other pilots, the approach and runway lighting could be seen during the approach on the ILS.

On the accident profile, the runway can be seen until 7 NM ILS-DME then it is obscured by the Stadlerberg - at night, a "black hole" effect.

The Stadlerberg is not equipped with obstacle lighting.

Runway 14 is not equipped with precision approach lighting (PAPI).

The APP did not ask for a report, that the airplane was established. The crew of AZ 404 did not report "established" on ILS.

The Go-Around commenced shortly before the accident by the COPI was immediately stopped by the PIC.
3.2 **Causes**

The accident was caused by:

- False indication of VHF NAV unit No 1 in the aircraft.
- Probable altimeter misreading by the PIC.
- No GPWS warning in the cockpit.
- Pilots not aware of the possibility of incorrect indications in the NAV equipment in use (without flag-alarm).
- Inadequate failure analysis by the pilots.
- Non-compliance by the pilots with basic procedural instructions during the approach.
- Unsuitable cooperation between the pilots during the approach.
- COPI’s initiated go-around procedure aborted by the PIC.
- The Approach Controller not observing the leaving of the cleared altitude of 4000 ft QNH before the FAP.

4. **RECOMMENDATIONS**

1. NAV equipment which does not have monitoring of the output signal should no more be used.
2. The Drum Pointer altimeter as fitted to the accident aircraft should not be used with immediate effect.
3. The GPWS should operate also in case of a NAV-failure.
4. It should be evaluated whether it should be allowed that all navigation instruments can be switched onto one receiver as a normal procedure.
5. The flight procedures of an air transport company should ensure that a Go-Around once started can not be stopped.
6. The air transport company flight procedures have to define the so called simulated CAT II and CAT III procedures and to ensure that the same procedures are used as are used for approaches when the weather conditions are CAT II or CAT III.

7. It should be evaluated whether by issuing a personal set of Route Manuals to each pilot, a better preparation could be made.

8. The approach charts in the Route Manual should show the horizontal terrain profile below the glide path.

9. The duties of the Approach Traffic Control should be expanded to include the task of warning in the event of an altitude undershoot of the Minimum Safe Altitudes. In this respect, a warning system similar to that used in the USA (minimum safe warning system) which gives an automatic optical and acoustic warning when an aircraft undershoots an altitude should be added to the ATC equipment.

10. The instructions in ICAO document 4444 should be reformulated so that in the area of transition between radar vectoring and pilot interpreted approaches there is no possibility for misinterpretation.

11. The instructions in the SWISSCONTROL manual of ATC volume 1 should be reformulated so that in the area of transition between radar vectoring and pilot interpreted approaches there is no possibility for misinterpretation.

12. The national and international operating instructions for ATC should be adapted to modern technology much faster.

13. The installation of an area microphone recording system for the Air Traffic Controller stations (similar to the aircraft CVR area mike) should be evaluated.

14. Obstacle lighting should be installed on the Stadlerberg.

15. ILS RWYs should be fitted with optical approach aids (PAPI).

Berne, 27th January 1993

Aircraft Accidents Inquiry Board

H. Angst
President
Übersichtsplan der Absturzstelle
Piano di situazione dell’incidente
View of the accident-site
Anflugprofil der Alitalia DC-9-32 AZ 404 am 14. November 1990 in Zürich
Profilo d’avvicinamento del DC-9-32 dell’Alitalia AZ 404 il 14 novembre 1990 a Zurigo
Approach profile of Alitalia DC-9-32 AZ 404 on November 14th 1990 in Zurich
Anflugprofil der AZ 404 (ILS-Anflug)
Profilo d’avvicinamento dell’AZ 404 (Avvicinamento ILS)
Approach profile AZ 404 (ILS Approach)
AZ 404: Radaraufzeichnung des Flugweges
AZ404: Registrazione radar del percorso di volo
AZ404: Radar plotting of flight path
Subject: ACCIDENT A2404 of November 14th 1990

Abbreviations and Call Signs:
- ACC = ZURICH RADAR
- ARR = ZURICH ARRIVAL
- ARR-C= ZURICH ARRIVAL INTER-COM
- TWR-C= ZURICH TOWER INTER-COM
- CVN-C = ZURICH ACC EAST SECTOR INTER-COM
- CVN-C = ZURICH ACC NORTH/SOUTH SECTOR INTER-COM
- CVN-C = ZURICH ACC WEST SECTOR INTER-COM

Frequencies:
- 128.050 MHz = ZURICH ACC NORTH/SOUTH SECTOR RADAR (ACC)
- 118.000 MHz = ZURICH APPROACH WEST SECTOR RADAR (ARR)

Times:
UTC in hours, minutes and seconds

Remark:
All figures which are not spoken according to standard RTF phraseology are written in words.

Büro für Flaggenfalluntersuchungen
Fachgruppe Flugsicherung

The following members of the Accident Investigation Team certify the completeness and correctness of the present transcript:

Markus Forster
Thomas Wieder

Version 2 - 23.11.90
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404 ACC .40 ANS04 ZURICH good evening squawk 6234 
404 ACC 6234 coming 
N04 ACC .51.20 A2A04 radar contact maintain FL 200 
ACC 404 maintaining 200 qna 
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ACC 404 404 fly on heading 350 
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ACC 404 318.0 good-bye 
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AIR 404 A2A04 descend to FL 90 
588 AIR 404 and continue down 90 
588 AIR IBE588 turn right heading B30 

Version 2 - 23.11.60
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<td></td>
<td>unknown station</td>
<td></td>
</tr>
<tr>
<td>SSB10</td>
<td>ARR</td>
<td></td>
<td></td>
<td>DLN5510 contact TWR 118.1</td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>SSB10</td>
<td>.10</td>
<td>118.1</td>
<td>byw</td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>1855</td>
<td></td>
<td></td>
<td>DLU1855 descend to 4000 FT</td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>1855</td>
<td></td>
<td></td>
<td>down to 4000 DLU1855</td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>SBB</td>
<td>.30</td>
<td>0155</td>
<td>IBE588 is maintaining 70</td>
<td></td>
</tr>
<tr>
<td>SBB</td>
<td>ARR</td>
<td>1855</td>
<td>18.58.50</td>
<td>DLU1855 confirm your heading?</td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>1855</td>
<td></td>
<td></td>
<td>IBS 260 DLU1855</td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>1855</td>
<td></td>
<td></td>
<td>roger</td>
<td></td>
</tr>
<tr>
<td>HQL</td>
<td>ARR</td>
<td>.50</td>
<td>00</td>
<td>turn right heading 030 radar vectors to the ILS 14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HQL</td>
<td></td>
<td></td>
<td>0000 vectoring for 14 HQL</td>
<td></td>
</tr>
<tr>
<td>HQL</td>
<td>ARR</td>
<td>.20</td>
<td>01</td>
<td>right heading 030</td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>HQL</td>
<td></td>
<td></td>
<td>030 QL</td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>863</td>
<td></td>
<td></td>
<td>ZURICH ARRIVAL good evening FIN863</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>passing 135 down to 90</td>
<td></td>
</tr>
<tr>
<td>863</td>
<td>ARR</td>
<td>.40</td>
<td>0158</td>
<td>ZURICH ARRIVAL good evening continue to SHA vector to the ILS 14 descend to FL 60</td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>863</td>
<td></td>
<td></td>
<td>down to FL 60 rh say again the rest of message</td>
<td></td>
</tr>
<tr>
<td>863</td>
<td>ARR</td>
<td></td>
<td></td>
<td>I call you back for radar vectors but for the time being continue to SHA</td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>863</td>
<td></td>
<td></td>
<td>continue as filed roger after SHA rh...</td>
<td></td>
</tr>
<tr>
<td>863</td>
<td>ARR</td>
<td>16.00.00</td>
<td></td>
<td>TNA then down to 40 FIN863</td>
<td></td>
</tr>
<tr>
<td>1855</td>
<td>ARR</td>
<td>.10</td>
<td></td>
<td>DLU1855 left turn heading 240</td>
<td></td>
</tr>
<tr>
<td>1855</td>
<td>ARR</td>
<td></td>
<td></td>
<td>left 240 DLU1855 how many track miles about please?</td>
<td></td>
</tr>
<tr>
<td>1855</td>
<td>ARR</td>
<td></td>
<td></td>
<td>DLU1855 15 miles to go</td>
<td></td>
</tr>
<tr>
<td>863</td>
<td>ARR</td>
<td>.20</td>
<td></td>
<td>FIN863 turn right heading 220 radar vectors to the ILS 14</td>
<td></td>
</tr>
<tr>
<td>863</td>
<td>ARR</td>
<td></td>
<td></td>
<td>right heading 220 FIN863</td>
<td></td>
</tr>
<tr>
<td>HQL</td>
<td>ARR</td>
<td>.30</td>
<td></td>
<td>HQL descend to 5000 FT QNH 1019</td>
<td></td>
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<td></td>
<td>HQL</td>
<td></td>
<td></td>
<td>HQL 5000 QNH 1019</td>
<td></td>
</tr>
<tr>
<td>0004</td>
<td>ARR</td>
<td>.30</td>
<td>01</td>
<td>AZA404 turn right heading 340</td>
<td></td>
</tr>
<tr>
<td>0004</td>
<td>ARR</td>
<td></td>
<td></td>
<td>right 340 AZA404</td>
<td></td>
</tr>
<tr>
<td>0004</td>
<td>ARR</td>
<td>.00</td>
<td>0100</td>
<td>IBS588 turn right heading 070</td>
<td></td>
</tr>
<tr>
<td>0004</td>
<td>ARR</td>
<td></td>
<td></td>
<td>right 070 IBE588</td>
<td></td>
</tr>
<tr>
<td>1855</td>
<td>ARR</td>
<td>.20</td>
<td></td>
<td>DLU1855 turn left heading 160 cleared ILS approach 74</td>
<td></td>
</tr>
<tr>
<td>1855</td>
<td>ARR</td>
<td></td>
<td></td>
<td>left 160 cleared ILS 14 DLU1855</td>
<td></td>
</tr>
<tr>
<td>588</td>
<td>ARR</td>
<td>.30</td>
<td></td>
<td>IBE588 reduce to 180 kph descend to 4000 FT QNH 1019</td>
<td></td>
</tr>
<tr>
<td>588</td>
<td>ARR</td>
<td></td>
<td></td>
<td>reducing 180 4000 FT QNH 1019 IBE588</td>
<td></td>
</tr>
<tr>
<td>HQL</td>
<td>ARR</td>
<td>.50</td>
<td></td>
<td>HQL descend to 4000 FT</td>
<td></td>
</tr>
<tr>
<td>HQL</td>
<td>HQL</td>
<td></td>
<td></td>
<td>4000 QL</td>
<td></td>
</tr>
</tbody>
</table>

Version 2 - 23.11.60
HQL ARR 19.01.50 your speed QL?
ARR HQL 160 QL
HQL ARR .02.00 roger maintain
ARR HQL will maintain
HQL ARR thank you
404 ARR 230 KT reducing 404 — — — cockpit sound
HQL ARR right 120 cleared on ILS 14 BLEEB
ARR BLEEB turn right heading 120 cleared ILS approach 14
ARR BLEEB gear warning here?
588 ARR BLEEB 120 cleared for approach 14 QL
ARR BLEEB gear warning here?
588 BLEEB turn right heading 120 cleared ILS approach 14
ARR BLEEB ILS 14 BLEEB
ARR 404 BLEEB descend to FL 60
ARR BLEEB 30 down 60 AZAAD
ARR BLEEB established 14
1858 BLEEB FLH1858 contact YVR 118.1 bye-bye
ARR BLEEB 118.1 FLH1858 bye
ARR BLEEB A2A04 turn left heading 325 again
ARR BLEEB 9.2 FLH1858
ARR BLEEB FLH1858 report speed?
ARR BLEEB 588 speed new 220 FINBEB
ARR BLEEB FLH1858 report speed?
ARR BLEEB FLH1858 report speed?
ARR BLEEB FLH1858 report speed?
ARR BLEEB FLH1858 report speed?
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ARR BLEEB FLH1858 report speed?
ARR 1834 06:00 ZURICH guest abig DLH1834 out of 105 for level 90 on-course STA
1834 ARR DLH1834 ZURICH ARRIVAL good evening |

break break break |

AIR 404 11:10 ZURICH Favone turn right heading 070 |
AIR 404 ARR 12:00 Right 070 ZURICH |

1863 ARR FIN563 descend to 4000 FT turn left |

heading 160 cleared ILS approach 14 |

AIR 1863 12:30 down to 4000 left heading 160 cleared |

ILS 125 FIN563 roger |

ARR HQL 13:00 HQL fully established and may we reduce |

speed? |

HQL ARR 13:10 Or reduce to 130 KT |

ARR HQL 13:30 LGP LGP |

HQL ARR 13:50 LGP LGP |

AIR 1863 14:30 start reducing speed for further up |

wning one-thirty and contact THR eighteen |

one bye-bye |

ARR HQL 14:50 roger speed 80 one thirty and over |

to THR |

.05:00 guest nacht |

C/M-IC ARR-IC 06:00 ja |

ARR-IC C/M-IC 06:00 Willissau cleared d’r MOR uf achtz |

C/M-IC ARR-IC 06:00 ja meri |

1834 ARR 10:00 DLH1834 turn right heading 310 roger |

vectors to the ILS 14 descend to FL 20 |

1834 ARR 10:30 roger present position right-turn 310 |

out of level 90 for 70 DLH1834 |

404 ARR 10:50 AZA404 descend to 4000 FT turn right |

heading 110 cleared ILS approach RTH 14 |

QNH 1019 |

AIR 10:19 14:00 FT right-turn on 120 to |

intercept RTH 12 |

AIR 10:30 Maintain two-ten-four—o—four |

ARR 10:40 two-ten maintaining |

932 ARR 10:50 RBB322 desired, required speed two |

twenty |

ARR 10:50 roger RBB322 speed two-twenty |

1834 ARR 11:00 DLH1834 reduce to two-twenty |

1834 ARR 11:30 speed two-twenty 1834 |

932 ARR 12:00 RBB322 turn left heading 245 |

1834 ARR 12:30 left heading 245 RBB322 |

1863 ARR 07:30 FIN563 reduce to, speed to one-sixty |

1863 ARR 08:00 reduce one-sixty FIN563 |

404 ARR 08:10 AZA404 reduce to one-eighty |

AIR 10:40 18:40 reducing now one-eight 404 |

1834 ARR 10:00 DLH1834 turn left heading 250 |

1834 ARR 10:30 left 250 DLH1834 |

1834 ARR 11:00 and 1834 descend to 5000 QNH 1019 |

AIR 10:30 roger 5000 on 1019 we have EBO 1834 |

1834 ARR 11:30 roger |

Version 2 - 23.11.90
ARR 812 08.00 ZURICH ARRIVAL quoted for MOR612 FL 60
812 ARR proceed to ERKRON expect vectors to the ILS 14
ARR 812 MOR612 proceeding to ERKRON
932 ARR RR6932 descend to 4000 QNH 1019
ARR 932 .20 descending to 4000 QNH 1019 RR6932
404 ARR .30 AZA404 reduce to 160 KT
ARR 404 reducing 150
653 ARR FIN863 reduce to final approach speed
ARR 863 .40 final approach speed FIN863
932 ARR RR6932 reduce to one-eighth
ARR 932 reducing 180 KT RR6932
812 ARR .50 MOR612 descend to FL 60
ARR 812 leaving 80 down to 60 MOR812
653 ARR .05.00 FIN863
932 ARR .10 RR6932 turn left heading 160 cleared
ILS approach 14 report established
ARR 932 .20 left 180 call you established ILS 14 RR6932

ARR 863 .50 FIN863 ON inbound
653 ARR yeah change to TKR eighteen one plessy
ARR 863 .10.00 eighteen one FIN863 good-bye
THR 458 ZURICH THR ... illegible
1834 ARR DLH1834 descend to 4000 FT reduce to 180 KT
THR 458 ... illegible
1834 ARR sorry DLH1834 you have been blocked out I say again descend to 4000 FT
.20 reduce to 180 KT
ARR 1834 Str we are out of five for 4000 one-eighth KT DLH1834
812 ARR RR6932 turn right heading 040 radar vectors to the ILS 14
ARR 812 .30 vectors to the ILS 14 right heading 040 for ILS radar vectoring I4 MOR812
404 ARR .40 AZA404 speed reduction as convenient 4 miles behind on BC5 contact TKR eighteen one good night
ARR 404 118.1 good bye
932 ARR .50 RR6932 speed back one-sixty
ARR 932 19.10.50 roger reducing RR6932

ARR-IC THR-IC .11.20 ja go
THR-IC ARR-IC .30 het dir AZA404 grueßt!
ARR-IC THR-IC AZA404?
THR-IC ARR-IC ja ... Ich verschwunden von Radar
ARR-IC THR-IC ja sagt recht
THR-IC ARR-IC ja süß bi öpppe 4 Meile stil rief um mal uf

Version 2 - 23.11.90
ARR-IC THR-IC ja rüf en hän
THK-IC ARR-IC .40 ja
1834 ARR .11.20 DLH1834 turn left heading 160
THK-IC ARR-IC cleared ILS approach 14
ARR 1834 .11.30 Roger left 160 cleared ILS 14
THK-IC ARR-IC Added on Nov. 22, 1991
DLH 1834
404 ARR .40 0A4AP?
1834 ARR .50 DLH1834 reduce to 180 KT
ARR 1834 .12.00 to one-sixty DLH1834
THK-IC ARR-IC Hät er gekrönt?
ARR-IC THR-IC neih
THK-IC ARR-IC du dä isch verschwunde vom Radar
THK-IC ARR-IC güt mir kel Antwort
THK-IC ARR-IC glaub ich ja nüd
ARR-IC THR-IC wo isch är güt wo?
THK-IC ARR-IC ja bl 4 , 5 Melle
ARR-IC THR-IC .10 ja wart emal!
ARR 932 RBB932 established ILS 14
932 ARR .20 RBB932 Roger
932 ARR RBB932 do you have an aircraft in
THK-IC ARR-IC sight about 2 miles ahead of you?
ARR 932 .30 standby
ARR 932 .30 there is a fire on ground but we have
THK-IC ARR-IC no traffic in sight
932 ARR .40 yeah DE roger
THK-IC THR-IC ja
ARR-IC THR-IC du AFA420 sichten.... sicht ab-
ARR-IC THR-IC bl 6 Melle? 50
THK-IC ARR-IC ja, sofort Vol-Alarm machen
ARR-IC THR-IC Ja guet Vol!...
932 ARR RBB932 approach clearance is can-
1834 ARR .13.00 cancelled climb to 5000 FT
THK-IC ARR-IC DLH1834 approach clearance is can-
ARR 1834 .10 cancelled climb to FL 60
ARR 1834 .10 again for 1834
ARR 1834 approach clearance is cancelled climb
ARR 1834 .20 Roger we are starting a go around
ARR 1834 straight ahead level 60 confirm?
ARR 1834 that is correct continue on present
ARR 1834 heading for the time being
ARR 932 ARR .30 RBB932 turn left proceed to SHA
ARR 932 and hold
ARR 932 Roger turning left to SHA and hold
RBB932
812 ARR 19.13.30 HBB812 turn left proceed to EKRON
ARR 812 .40 track 320 and hold
ARR 812 .50 EKRON track 320
ARR 932 RBB932 maintaining 5000
932 ARR RBB932 yeah
1834 ARR .14 QQ DLH1834 do you have ground contact?
negative
and we are in clear up to 5,000
feet. 5,000 BRS2, climbing to FL 70. After
5000, overshoot. Old man is climbing to 60 BRS2.

For negative, overshoot and
After 5000, overshoot. Old man is climbing to 60 BRS2.
812 ARR   17.10  HORB12 did you copy?
812 ARR   17.20  HORB12 we copied
812 ARR   17.10  yeah we have an emergency and the air-
port is closed due to that
812 ARR   17.30  HORB12 for your information your posi-
tion is 3 miles east of EKRON
812 ARR   17.20  HORB12
812 ARR   17.40  your position is about 3 and a half
miles east of EKRON
812 ARR   17.50  did you copy HORB12?
812 ARR   18.05  HORB12 we are in a right turn now
maintaining 60 and we proceed to
the the EKRON holding ...21

ARR  153   18.00  ARRIVAL Qute Asig BBB153 level 150
descending 90 with ECHO

ARR  153   18.10  BBB153 ZURICH ARRIVAL good evening
    proceed to EKRON and hold maintain
    FL 90 when reaching indefinite delay
    the airport is closed

ARR  153   18.20  BBB153 EKRON and hold indefinite de-
    lay

ARR  153   18.30  we have an emergency

ARR  153   18.30  OK BBB153

ARR  1834   18.40  DLH1834 entering 5000 holding FL 20

rger DLH1834 new controller

--- END ---

Version 2 - 23.11.90
Beilage / Annesso / Annex 6

Originalprotokoll des CVR der AZ 404 vom 14.11.1990 (Italienisch-Englisch)
Protocollo originale del CVR del volo AZ 404 del 14.11.1990 (Italiano-Inglese)
Original CVR transcript of AZ 404, 14.11.1990 (Italian-English)
Final Draft, 7. May 1991

18:39:30 ATC AZA 404 Milano.
AP Go ahead.
ATC Climb to level 140 call Milano radar 127.45.
AP 127.45 up 140 claro.
AP 349 te l'ho messo.
FP Si grazie.

18:40:00 AP Buona Sera Milano AZA 404 up 140.
ATC Buona Sera 404 on the radar climb to FL 200.
AP Up 200.
AP Seccionala - allora possiamo anche...

18:40:30 ATC AZA 404 proceed direct to Saronno - eh connection to Canne.
AP Thank you straight ahead Canne 404.
FP Allora...
AP 313 te lo scrivo qui.
FP ... 327. Perché 313?
AP Eh 313 per andarlo a chiamar direttamente a Canne no? Ca 313 va a Canne. Hai visto? Va a Canne.
FP Diciotti da qui, eh?
AP Eh.
FP Qual è scritto 327...
AP Va 327...
FP E noi dove siamo adesso?
FP E ma io devo dire basta a questo qua...
AP E che ci vo' c'è?
FP Adesso là ci mettiamo...
AP 13.7... va bo?
AP 13.7...340 mi sembra quant'è va be 350.
FP Le minime quanto diventano 120 a - ?
AP Adesso le minime te le devi far tu. Canne 18 deve essere 120 e poi va subito a 150 nelle 32 miglia. Non c'abbiamo più problemi no?
FP Accelero a 450.
AP Guarda solo se c'è ghiaccio perché io non trovo più la mia torcia.
PP No già guardato. Rimetti... 
AP Siamo fuori?
PP No.
AP C'è una sfavata dei.
AP Non lo trovo - appena ce l'avevo. 
...l'ho pagata 11000 lire.
FP (Laughing)
AP L'ho pagata 11000 lire oh!
FP 150 l'abbiamo fatta - accelerare a 290.
...Zurigo pista 16, company, ground.
Allocation, departure, ramp, atis 129,52.

FP
C'è l'AITIS di Zurigo no?
AP
Ebbene si, ...tutte le minime da considerare...uno...
32 miglia ruoli.

FP
Abbiamo letto l'after takeoff?
AP
L'abbiamo letto no?
FP
Si - questo qua sta sempre a zero.
FP
Qua c'è eh?
AP
C'è eh lo vedo. Bene allora gli diamo una
risoldata pure all'altro sistema. visto
che è abbondante qui.

Solo pe daje...

CLICK
la coda vedì. Allora viene 200 30 50.
AP
Pezz i motori tielli...
FP
...
AP
Ma che C(((((( vede tutto sotto io.
FP
Sotto si ma sopra no.
AP
...
FP
Approaching 200.

ALTI TIDE ALERT SOUND
AP
Melty bere...

:04:51:10 AP
AP 204 maintaining 200.
ATC
Zurich Milan roger.
AP
Eniene freqa niente.

ZURICH VATS
CLICK CLICK
AP
Togliamo il ghiaccio.

ZURICH VATS
AP
Benissimo eventualmente andiamo a Bale che è
abbastanza buono. Ha finito quasi do picco.
Zurigo dà 240 8 adesso da eh!
FP
eh quindi - ...
AP
Sarà un circling!
MARKER "BRUNNEN"
AP
Allora fatti vedere per la pista 28 -
FP
Abbiamo...
CLICK CLICK
AP
Per la pista 28 che è quella che ci interessa
a noi da 240 6...

ZURICH VATS
AP
Eh?
FP
Me lo passi anche a me?
AP
Bollettino Delta informa la pista per
adesso è ancora la 14 e la 28 da 210 8 rendi
sulla 18 6 nodi però danno la 14, 9 kilometri
3 a 1400, 5 a 3000, 7 a 4000, 9 con 8 1019.
Risulta tutto lo allora - come dici tu, come dici tu...

CVB Track Change

FP La costa giù alla abbiamo data?
AP Si è solo per la costa che l'avevo dato.
FP Va bô! Allora stesso sull'uno ci possiamo mettere Trasadingen.
AP Allora io ti metto Tras...13.7 qui - poi radio uno di qua e metto 116.4 - Trasadingen ci rosta...Sul ci serve per l'arrivo noi?
FP OK!
AP Kitchen lo mettiamo di qua e poi dopo - CXXX - o forse ti interessa più Kloten di là vero? Ma si così' Kloten ce l'hai fino alla fine.

AP Vai avanti. - Go ahead.
ATC A3A 404 Radar 128.05. Buona sera.
AP 128.05 ciao a fra pocc.
AP OK 116.4 be l'ha messo sul numero due.

18:50:40 AP Buona sera Zurich A3A 404 maintaining 200.
ATC A3A 404 Zurich good evening squawk 6234.
AP 6234 cos'è.
AP 90 - trassa sullo stesso valor di 349...- Eventualmente, la 28 dove c'hai left right hand quindi vai do te pare.
FP Arriviamo, rampiamo e sinistra, manteniamo la pista visto che sono io il PF sulla destra, così' la vedi, ti va bene?

18:51:20 ATC A3A 401 radar contact maintain FL200.
AP Maintain 200 484.
AP Guarda bene la pista, ce l'hai qua no?
FP SI.
AP Per mantenere sulla destra tu fai così...
FP SI.
AP Se tu invece segui ad andare diretta fino al centro pista...
FP Eh...
AP Tu la pista...la vedo e ti fa così... sottovoce almeno sei sicuro che ce passi sulla pista, non te la perdis più. Io una volta ringreno qui andando sottovoce se so perduto e qui ce so' le montagne uh.
XX Overhead the aerodrome, turn left turn downwind left turn.
XX ...stiamo tranquilli, poi tu...
AP Perfetto... oh hai capito io te guardo sempre la pista e - tu vai sempre uno
strumentale fino al traverso e tu sei sempre uno strumentale e poi dopo
dritto... fino all'ultimo quarto e
questo... ci allontaniamo in modo tale a
1200... sono 25 - 30 - 35 secondi.

FP  Si a 1390 - 1015 man?
AP  1019 affermativo.
FP  970.
FP  Va bene.
AP  Ho te lo dissi in discesa eh?
XX  ...la pista è a 14...
AP  ...ci sei quasi vicino... VOR... controlla...
FP  ...
AP  In avvicinamento c'abbiamo 15000 fino

13:53:40 ATC AAZ 404 your heading?
AP  404 flying on heading 350.
ATC  Fly heading 340

AP  Va be' perché....
ATC  AAZ 404 descend to FL 140.
ATC  Down 140 AAZ 404 leaving.

CLACK CLACK
AP  Ambasciata - minima - controllata.
FP  Checked.
AP  Poi ci abbiamo 100 da lasciare
per Albut che sono 10 miglia e il
traverso lo possiamo fare intorno ai
7 8 mile.
FP  Da mantenere 8 mila poi ci manda su
sbarco...
AP  81.
FP  5 mila, il glide è di 3 gradi.
AP  l'outer marker a 1084 sull'echo,
che lo appoggiamo anche...dietro...
AP  Se mi riduci un po' la velocità...

ZURICH ATIS
AP  ...è cambiato eh.
ZURICH ATIS
AP  Va benissimo, eventualmente se vedo
che in finale siamo un po' veloci e
non ti va bene puoi chiamare anche flap
a 30 ma non ci sono problemi perché
la pista è lunga... massimo 7 8 nodi.
FP  ...allora 250 e la nostra minima...
CA  Comandante - chiedo scusa faccio
l'annuncio della discesa?
AP  Si stiamo aprendo. Tra 15 minuti
saremo touch down e...
18:55:40 ATC A2A 424 descend to FL 100.
19:55:30 AP Continuing down 300 404.
AP IL tempo è...con 9 gradi sopra.

THROTTLE IDLE SOUND
CA grazie.
FP Questo a Klooten - qua abbiamo messo 332 Rhine tutt’e due d’accordo?...-
AP Avere se fai una domanda che sicuramente vuole l’hai sotto controllo.
Ma se per caso adesso non lo sappiamo più dove CXXXA andiamo, hai su...
FP Se non sappiamo più chi li controllo. Avaria radio?
AP Il controllo, eh l’avaria radio.
FP Riportiamo - allora andiamo verso Klooten facciamo la procedura standard andiamo verso Ekron che...l’initial approach fix...
AP Andiamo su Klooten...
FP Da Klooten?
AP Da Klooten puntiamo su Ekron manteniamo sempre quel 7 mila...
funzione...arriviamo su Ekron...andiamo a Ekron aspettiamo se stiamo in orario...andiamo via subito facciamo la procedura standard...

19:57:10 ATC A2A 404 contact arrival 112.00 good bye
AP 111.00 good bye.

19:57:30 AP Arrival good evening. A2A 404 descending 100 echo received.

19:57:40 ATC A2A 404 Zurich Arrival good evening. Fly heading 325 radar vectors to the ILS 14.
AP Radar vectors to runway 14 on heading 325 404.

19:57:50 ATC A2A 404 descend to FL 90.

19:57:50 AP Continue down 90.

XX ...
A2 Sulla pista 14 come veili dobbiamo mettere quasi verso la fine...
XX ...la riattaccata...
AP Allora la riattaccata te no vai a Wallisellen...
NDB che l’abbiamo sul numero due non serve a niente perché è un NDB lo capisci. Dobbiamo gireare a sinistra e da lì...andiamo fino in fondo pista e giriamo a sinistra per Schaffhausen.

FP Schaffhausen lo appoggeremo qui.
A2 ...362 te lo metto qua. Schaffhausen a
5000 affermativo. Tu vai in fondo pista e giri a sinistra e te ne vai su Schaffhausen e dei sul numero 2.

**FP**...la visibilità quant'è?
**AP**La visibilità è 9 kilometri.
**FP**Salento a 250.
**AP**Bravo.
**FP**Pazziamo categoria due.
**AP**Sì perché la dobbiamo provare.
**FP**...allora metto qua...
**AP**Questo l'aveva la categoria due? Sì?
**FP**Mettemo le minime di cat due?
**AP**Dobbiamo provare il...93.
**FP**93
**AP**Allora quant'è? 93?
**FP**No io leggo 93...95...95
**AP**Abbiamo guartato la stessa pista sì?
**FP**No.
**AP**Ah ecco...
**FP**...com'è la riatattacca?
**AP**La riatattacca poi gira a sinistra per Schaffhausen.
**FP**Ah ecco perché non ero d'accordo su quello che dicevo ma che ci vai a fare sulle bache - ...stessa pista...
**AP**Servirà per un'altra volta.
**AP**Va bene l'importante...

**FP**...
**AP**...è che poi si capisce. Quando tu non sei d'accordo...io t'ho detto non ci andare su quel bache...vai direttamente a sinistra, vedi l'avevo messo...
**FP**...io ti ho detto due volte perché. Tu mi hai detto perché tiamo vedi. La stessa pista...
**AP**Sì, no quest'altra è obbligatorio andare eh.
**AP**Quèl obbligatorio andare perché gii ci sta una quota di '627 piti a vedi è sì al quella.

9:00:50 **ATC**Ma 404 turn right heading 340.
9:01:30 **AP**Right 340 Ma 304.
**AP**Quando...com'è d'accordo?
**AP**Era se forse non ha capito io - ma perché mi dici che io ero convinto che che tu mi avessi detto perché...mi dici di mettere Willeisem...

**FP**Eh...
**AP**Però non è vitale non è importante perché mi dici quando c'hai quel valore
di Wallisellen gira a sinistra... capisci
invece quell’altro dice no, vai diritto
proprio su Wallisellen... no per chiarire
vorrei chiarirlo eh eh perché se no...

diamo al traverso di Kloten a livello 90
per cui ci porta alti eh!

Siamo al traverso di Kloten a livello 90
per cui ci porta alti eh!

Infatti io devo riferire ancora di più
perché superato il traverso è inutile
correre, può corri più l’alloranti capitato?
E se poi l’allonzano io minore ti salgono.

Stavolta...

Tanto sta al traverso... più vai piano è
meno tempo impiegato per l’atterraggio.

AZA 404 reduce to 210 knots.

19:02:19 AP

210 knots reducing 404.

THROTTLE LESS SOUND

AP

DAI VIVI?

AZA 404 descends to 620.

19:02:30 AP

Down 620 AZA 404.

THROTTLE FULL SOUND

AZA 404 turn left heading 125 again.

19:02:50 AP

Left 235 404.

TRIM

Consiglio riduci a 200 nodi perché tu che tanto
è inutile correre... sono già 5 miglia Out.

CLICK CLICK

...andando verso Ekron... eccellente...

...matto l’inbound 088 per andare...

TRIM

49...59...69.

AP

Ci sono nove gradi. Quindi non ci occorre
l’antighiacchio qui. Siamo al limite... adesso
ci sono 6 gradi.

ALTITUDE ALERT SOUND

AP

L’outer marker è a 200 determinabili anche
dai 3 da Kloten. Rhone 5,6...

13:05:15 AC

Lufthansa 1834 zurich Arrival good evening
grand by. Break break. AZA 404 turn right heading 070.

9:05:20 AP

Right 070 AZA 404.

CLACK

TRIM

MORSE CODE

AP

India Kilo Lima.

9:06:20 ARK

AZA 404 descend to 4000 feet, turn right
heading 110, cleared ILS approach runway 14.

QNH 1015.

9:06:30 AP

1019 4000 feet, turn right heading 120 to
intercept runway 14.

ATC: Maintain 210 404.
AP: Two ten maintaining.

CLICK CLICK CLICK
19:06:45 AP: 3100 Feet.
19:07:15 AP: Quanti'è l'aeroporto?
19:07:25 AP: 125 sulla salmone va bene. La riattaccata a memoria.
19:07:25 AP: 37 40 doppiante 183 Schaffhausen.
AP: Perfetto.
FF: 5000 sul due.
19:07:25 FF: Cos'ha detto? 10?
AP: (Contemporaneamente) 10 tolgo tutto.
CLICK CLICK CLICK
FF: Autorizzati a seguire?
19:07:25 AP: Autorizzati fino a 4000 piedi dopo di che a intercettare e seguire.
FF: Vai.
ATC: A2A 404 reduce to 180.
19:07:25 AP: ...no, hai detto 10?
19:07:25 AP: ...no uno non...ce l'ho.
19:07:29 AP: Benissimo, allora lo facciamo sull'uno.
FF: Radio uno.
19:08:09 FF: Flaps...
19:08:20 AP: Kiosk un tantino la velocità...
TAP TAP TAP
ATC: A2A 404 reduce to 180 kts.
19:08:47 AP: ...capture Loc captare Glide Path capture, quindi slamo nel fascio catturato un poco apportati ma...
19:08:36 ALTITUDE WARNING SOUND
19:09:01 AP: 150.
19:09:09 AP: Cancello e scendo 5000.
(COMM DOWN?)

TRIM
19:09:16 AP: Se ne abbiano uno abbastanza vicino. Metto anche 150 se no va a finire che schiaffano na riattaccata.
19:09:33 AP: C'è ghiaicciolo.
19:09:35 AP: No no, praticamente no, c'abbiamo 10 gradi e 10 in terra.
Flaps 25.

19:09:47 AP Check the outer marker. It's 1250 to the.
19:09:52 AP Flaps fifty metissimo...f23.
19:09:52 AP Bravo.

19:10:12 AP ...3.5 miles away.
19:10:27 FP ...Non si passata...?
19:10:30 FP Non era passato l'outer marker?
19:10:30 AP No, no, non ha cambiato... oh, qui mi da 7.
19:10:50 ATC Aaa 484 speed now as convenient 4 miles behind a DC9 contact Tower eighteen-one. Good night.

19:11:01 AP Good night.

19:10:53 AP ...che non ne biora...
19:10:53 FP No ancora a me.
19:10:57 AP Tira su, tirasu, tira su, tira su.

19:11:09 FP Go around.
19:11:30 AP No, no, no, no I'm going to glide.
19:11:35 AP Ecco la tua a reggerlo?
19:11:13 FP Si.
19:11:14 PIP PIP PIP PIP PIP PIP PIP PIP PIP PIP PIP PIP PIP PIP
19:11:16 AP Aspetta proviamo a rim...
Beilage / Annesso / Annex 6a

Deutsche Fassung des CVR-Protokolls der AZ 404 vom 14.11.1990
Versione in italiano del CVR del volo AZ 404 del 14.11.1990
English translation of CVR transcript of AZ 404, 14.11.1990
18:39:30 ATC  ADA 404 Milano
AP  Go ahead
ATC  Climb to level 140 call Milano radar 127.45
AP  127.45 up 140 echo
AP  349 te l’ho assegn.
(AP habe ich dies eingesetzt)
FP  Si grazie.
(Ja danke)

18:40:00 AP  Ripresa verso Milano ADA 404 up 140.
ATC  Ripresa verso 404 on the radar climb to Fl 200
AP  up 200.
AP  Provvisoriamente — allora possiamo andare...
(Ancoradventitich — also können wir auch...)

18:40:30 ATC  ADA 404 proceed direct to Sar swollen — eh correction to Cannes.
AP  Thank you straight ahead Cannes 404
FP  Autorità...
(Auch...) 
AP  313 tu in servizio qui.
(313 scheint ich dir da)
FP  ...327, perché 313?
(...327, Warum 313?)
AP  Ah 313 per sordizio a chiaggio diretto a Cannes no? La 313 va a Cannes. Hai visto? Va a Cannes.
(313 um ihn direkt nach CANPE zu er wischen, oder? Die 313 geht nach CANNES. hast du gesehen? Geh nach CANNE.)
FP  Diretta da qui, eh?
(Direkt von hier, eh?)
AP  Eh?
FP  Qua è scritto 327...
(Da ist 327 geschrieben...)
FP  Ma 327...
(Aber 327...)
FP  E poi dove siamo adesso?
(Und wir wo sind wir jetzt?)
FP  E so dovo dare retta a questa qua
(Aber ich muss diesem folgen)...
AP: Sì che ci vuol tâ?
UF: Und was willst du machen?
AP: Adesso là ci mettiamo...
(Dein dürt setzen wir...) 
AP: 13.7...va be?
(13.7...ist es gut?)
AP: 13.7...349 mi sembra quant'è va be 350.
(13.7...349 es scheint mir, wieviel is es, 
vs ist gut, 350)
UF: Se minime quanto diventano 120 a ?
(Mic werden die Mindestflughöhen...120 
in...)?
AP: Adesso io minime lo lo devi la tu. Cane
12 deve essere 120 e pol va subito a 150 
helle 15 miglia. Non c'abbiamo più problemi
no?
(Netz musst Du die Mindestflughöhen er 
rechnen. CANNE 12 muss 120 sein und dann 
egen es sofort auf 150, innerhalb 32 Me-
ilen. Wir haben keine Probleme mehr, oder?)
UF: Accelero a 250.
(AP: Ich beschleunige auf 250)
AP: Guarda solo se c'è ghiaioio perché Io non 
travo più la mia torcia.
(Schau nur mal ob es Vereisung hat, weil 
ich meine Lampe nicht mehr finde.)
UF: Ho già guardato. Rimetti...
(Habe schon nachgeschaut. Selber wieder)
AP: Siamo fuori?
(Sind wir draussen?)
UF: No.
(Nein)
AP: C'è una sbavata dei.
(Es hat einen schleier, gib)
AP: Non la trovo - coprilo ciò l'avovo, ... l'ho 
pagato 11000 lire.
(Ich finde sie nicht, aber ich hatte sie...
habte für sie 11000 liren bezahlt)
UF: [Laughter]
AP: L'ho pagato 11000 lire oh.
(Habe für sie 11000 Liren bezahlt, oh)
UF: 150 l'abbandon' fatto - accelero a 290.
(150 haben wir's geschafft ich beschleu-
nige auf 290)
AP: ... Zurigo plata 16, company, ground.
delivery, doparture, ramp, atis 128.52
 UF: C'è FTF di Zurigo no?
(int das ATIS zu da, oder?)
AP: Abbiamo si.
(Also, ja.)
... l'ètte le minime da considerare... uno. 
22 miglia fuori.
(Alle Minima zu betrachten... eins. 32 
Meilen entfernt.)
UF: Abbiamo fatto l'after Takeoff?
(Haben wir den after Takeoff gelesen?)
AP
L'abiamo letto no?
(Heben wir ihn gelesen, oder?)

FP
Si - questo qua sta sempre a zero.
(Ja - dieser bleibt immer auf null)

FP
Qua c'è end?
(De ist er, eh?)

AP
C'è eh lo vedo. Bene allora gli diamo una riscaldato pure all'altra sistema, visto
che è ancora qui.
(Es ist da, eh, ich sehe es. Gut, dann heizen
wir auch das andere System, da es hier ja
reinlich ist.)

Click
Solo pe dajo....
(fum um nur zu geben)

Click
La cosa vede. Allora viene 200 88 89
(Sehe das Heck. Dann kommt 200 88 89)

AP
Però i motori: tioiiii...
(Aber die Motoren halten sie)

FP
....

AF
No che CXXX vede tutto sotto in...
(Aber was... ich sehe Alles nach unten)

FP
Sotto si ma sopra no
(Nach unten ja aber nach oben nicht)

AP
...

FP
...

FP
Approaching 200.

ALTITUDE ALERT? SOUND

AP
Molo bene.
(Sehr gut)

18:45:10
AP
AT 404 maintaining 200

AP
Gliene frega niente.
(Ke ist ihm egal)

ZURICH VOICE

CLICK CLICK

AP
Rennissimo eventualmente audiamo a Bala che è
abbastanza buono. Ha finito quasi de piave.
Zurigo da 240 a indossà da eh!
(Sehr gut, um uns alsbald geben wir nach
Kale, das ziemlich gut ist. En hat fast zu
gerne aufgehöht. Zurich gibt 240 a jetzt
gibt er es eh!)

FP
En quedi - ...
(Und dann - ...)

AF
Sarà un circling?
(Es wird ein "circling" sein)

MARKER "BRUHNEN"
Abbiamo...
(Wir haben...)

Per la pista 28 che è quella che ci interessa a noi la 240 è
(Für die Piste 28, das ist die, die uns interessiert, gibt es von 240)

ZURICH ATIS

Fr?
(Gibst Du es mir auch?)

Ho letto i dettagli informativi, la pista per
(sehr gut) ancora la 14 e la 28 da 240 6 nodi
(sulla 16 6 nodi, però nella 14, 9 kilo
metri, 3 a 1400, 5 a 3000, 7 a 4000, 8 con 8
1019.
Tutto tutto lo attura come dici tu, come
dici tu...
(Meldung ATIS Information, die Piste für
jetzt ist noch die 14 und die 28 gibt 240 6
Knoten, auf der 16 6 Knoten aber sie geben
die 14, 9 Kilometer, 3 auf 1400, 5 auf 3000,
7 auf 4000, 8 mit 8, 1019.)
Ich nehme also alles weg, wie Du sagst, wie
Du sagst)

CVR Track Change

La cosa è relativa abbiamo dato?
(Dem Herk haben wir es gegeben?)

Si è solo per la cosa che l'avevo dato.
(Ja ich habe es nur am Herk gegeben)

Va bene! Allora adesso sull'uno ci possiamo
mettere Trasadingen.
(Gut aber: Also auf dem eins können wir jetzt
Trasadingen setzen.)

Allora lo sto sotto Tras...13.7 qui - poi
radio uno di qua e metto 116.6 Trasadingen
e cons... sul... ci serve per l'arrivo no?
(Also ich sehe Dir Tras...13.7 da - dann
Radio eins auf dieser Seite setzte ich 116.6
Trasadingen bleibt... auf... wir brauchen es
für den Auflug.)

No!

Klopen io mettiamo di qua e poi dopo ~ CXXX
- a forse ci interessa più klopen di là verso.
Ne si così! Klopen cc l'hai fino alla fine.
[Klopen setzen wir auf dieser Seite und dann
machen... oder vielleicht interessiert
sich mehr Klopen auf der anderen Seite, oder?
Aber doch, so hast du Klopen bis am Ende.
18:50:20 ATC
AUA 404 Milano
AP
Vuoi avanti. – Go ahead.
(Vorwarts. – Go ahead.)
ATC
AUA 404 radar 128.05 buena sorra
(AUA 404 Radar 128.05 guten abord.)
AP
128.05 cinco a fra poco
(Tschau bis bald)
ATC
...OK 116.4 te l’ho messo sul numero due.
(...OK 116.4 habe ich DIR auf Nummer zwei gesetzt)

18:50:40 AP
Buona sorra zurich AUA 404 maintaining 200.
(Guten abend zurich AUA 404. . . .)
ATC
AUA 404 zurich good evening approach 6214
AP
3234 coming
AP
59 – Trasla sullo stesso valore di 399 . . . .
Eventualmente, la 28 dove c’hai left right
hand quindi vai do lo pare.
(59 – Trama auf den gleichen Wert von 399 . . . .
Unter Umständen die 28 wo du links/rechts hast,
dann gehe wo ca dir passi.)
FP
Arriviamo, rotoliamo a sinistra, manteniamo la
pista visto che sono io il nr sulla destra,
così la vedo, li va bene?
(wir kommen an, brechen noch links aus, balie
die Piste da ich ja der FP bin auf der rech-
ten, so sche ich sie, passt dir das?)

18:51:20 ATC
AUA 404 radar contact maintain FL200.
AP
Maintaining 200 404.
AP
Guarda bene la pista, ce l’hai qua no?
(Schau mal recht die Piste an, du hast sie
da, odòc?)
FP
Ja.
(AP)
Per mantenere sulla destra tu fai così...
(Um sie rechts zu halten, machst du so . . .)
FP
Ja.
(AP)
So tu invece segui ad andre diritto fina
al centro pista...
(Wenn du aber immer gerade guhst bis zur
Pistenmitte . . .)
FP
Ja.
AP
Tu la pista. . . la vedo è ti fa così...
sottovento almeno 80, sicuro che ce passi
sulla pista, non te la perdii poi. Io una
volta rompendo qui andando sottovento so no
perduta e qui ce sol’ia montaggio eh.
(Du die Piste. . . .nicht, Du und sie macht so . . .
Gegenwind, so bist Du wenigstens sicher, dass
Du über die Piste kommst und sie nicht mehr
verliertst. Als ich hier einmal in die Gegen
gerade ausgebrochen bin, habe ich mich verlo-
ren, und da hat es Nere eh.)
Overhead the aerodrome, turn left turn downwind left turn.

...stiamo tranquilli, poi su...

...Soien wir ruhig, dann Du...

Parfait... eh hai capito io lo guardo sempre la pista e tu hai sempre una strumentale fino al trisferto e tu hai sempre una strumentale e poi dopo 15 20 35 secondi. (Perfettamente... eh hai capito io lo guardo sempre la pista e tu hai sempre una strumentale fino al trisferto e poi dopo 15 20 35 secondi)

...a 1390 - 1019 nor

...auf 1390 - 1019 odor?

1019 affermativo.

1019 bestätigt, behabend

...auf 1390 - 1019 nor...

...auf 1390 - 1019 odor?

Va bene...

Gut so...)

Ich gebe es Dir im Sink(lug)

...la pista è 14...

...die Piste ist 14...

...ci sei quasi vicino... VON... controlli...

...Du bist fast nahe... VOR... Kontrollen

in avvicinamento c'abbiamo 15000 fino a Brunn 18000 fino a 10 - 10 - 28

(Im Anflug haben wir 15000 bis Brunn, dann ist 10 18 20)

18:53:40 ATC ASA 404 your heading?

ASA 404 flying on heading 390

ATC Fly heading 390

18:53:50 AP Left 40 ASA 404

AP Va bene' perché...

Gut so, warum...)

ATC ASA 404 descend to Fl 140

ATC Down 140 ASA 404 leaving

CLACK CLACK

Abbasata minima controllata.

(Ausgeflogen - Minima - Kontrolliert)

Cheked

Poi ci abbiamo 100 da lavorare per Alba che sono 10 miglia e il traverso lo possiamo fare intorno ai 7 8 miglia

(Dann haben wir 100 zu verlassen nach Alba, das 10 Meilen sind, und querab kommen wir um die 7 8 tausend machen.)
Da menzionare 6 mila poi ci manda su Ekron...
(8 tauzend einhalten, dann schickt er uns nach EKRON.)

AP Sì. (Ja.)

FP 5 mila, il glide è di 3 gradi, l'outer marker a 1040 sull'echo, che lo appoggiamo anche... dietro...
(5-tauzend, der Glide ist 3 Grad, der outer Marker auf 1040 auf dem Echo den wir dann anhängen? auch... hinten)

AP Se mi ritirerai ora la velocità...
(Wenn du mir ein bisschen die Geschwindigkeit reduzierst)

ZURICH ZRH

AP ...è cambiato eh.
(Noch gewechselt, ch.)

ZURICH ZRH

AP Va benissimo, eventualmente se vedrì che in finale siano un po' velocì e non ti va bene puoi chiamare anche flaps a 50 ma non ci sono problemi perché la pista è lunga... massimo 7-8 nodi.
(As ist sehr gut, eventuell, wenn Du siehst, dass wir im Endflug ein wenig zu schnell sind und es Dir nicht passt, kannst Du auch Flaps 50 verlangen, aber es gibt keine Probleme, weil die Piste lang ist... 7-8 Knoten.)

FP ...altrc 760 è la nostra minima...
(Also 760 ist unser Minimum)

CA Comandante - chieda suave faccio l'annuncio della discesa.
(Kommandant - Entschuldigung soll ich die Sinkflug-Annahme machen?)

AP Si stesso scendendo. Tra 15 minuti saremo touch down e...
(Ja wir sind im Sinkflug. In 15 Minuten sind wir touch down und...)

18:55:40 AIX ARA 404 descend to FL 100

18:55:50 AP Continuing down 100 444

AP Il tempo è... con 9 gradi coperto
(Des Wetter ist... mit 9 Grad bedeckt)

THROTTLE IDLE SOUN

CA ...grazie
(...Danke)
Questo è Kloten - qua abbiamo masso 322 Rhine
tutto bene d'accordo...
...in caso di turbolenza tengo 300 nodi.
(Da ist Kloten - da hier wir 322 Rhine
gezogen, beide, einverstanden?
...im Falle vom Turbulenz halte ich 300 Nioen.)

Adesso to faccio una domanda che sicuramente
tu ce l'hai sotto controllo. Ma se per caso
desso non lo sentiamo più dove CXXX
andiamo, dà su...

(Jetzt frage ich dich etwas das Du sicher
beherrschst. Wenn wir ihn zufälligerweise
nicht mehr hören, wo zum Teufel gehen wir?
Antwort...)

Se non sentiamo più chi? Il controllo, Avaria
Radio?
(Wenn wir nicht mehr hören? Die Flugver-
kehrsführung, Radioausfall.)

Il controllo, eh l'avarai radio.

(Rieportiamo. Allora andiamo verso Kloken fac-
ciamo la procedura standard andiamo verso
Ekrön che... l'initial approach fix...
(Wir meldeten - also dann gehen wir Richtung
Kloken, machen das Standard Verfahren Rich-
tung Ekrön welcher... der initial approach fix.)

Andiamo su Kloken...

(General wir Richtung Kloken)

Da Kloken?

(Von Kloken)

Da Kloken puntiamo su Ekrön manteniamo sempre
quei 3 mila... famosi... attiviamo su Ekrön
...andiamo a Ekrön aspettiamo su orario...
andiamo via subito facciamo la pro-
cedura standard...
(Von Kloken stechen wir Richtung Ekrön, hal-
ten immer die 3 tausend... bereit... kommen
über Ekrön an... gehen nach Ekrön, warten wir
wie auf Zeit sind - gehen sofort weg, machen
das Standard Verfahren)

18:57:10 ATC AZA 404 contact arrival 116.00 good by.

18:57:30 AP Arrival good evening. AZA 404 descending 100
meno inviato.

18:57:40 ATC AZA 404 Zurich good evening. Fly
heading 325 radar vectors to the LNS 14.

AP Radar vectors to runway 14 on heading 325
404.

ATC AZA 404 descend to FL 90.
18:57:50 AP Continue down 98.

XX ...

AP Sulla pista 14 come ve dobbiamo uscire quasi verso la fine. (Wie du siehst müssen wir auf der Piste 14 fast am Ende die Piste verlassen.)

XX ...la riattaccata...

AP (...der Durchstart...)

XX Allora la riattaccata te ne vai a Wallisellen NWZ che c’abbiamo sul numero due non serve a niente perché è un NWZ le capisci. Dobbiamo girare a sinistra e da li...andiamo fino in fondo pista e giriamo a sinistra per Schaffhausen.

(AP der Durchstart geht Du nach Wallisellen NWZ, dann wir auf Nummer zwei haben, er nützt nichts da es ein NWZ ist, verstehst Du? Wir müssen nach links drehen und von dort... gucken wir bis zum Pistenende und drehen auch links Richtung Schaffhausen.)

FP Schaffhausen lo approgorere qui.

(AP Schaffhausen die werden wir hier einstellen)

...362 le lo motto qua. Schaffhausen a 5000 argentivo. Tu vai in fondo pista e giri a sinistra e te ne vai su Schaffhausen e sei sul numero 2.

(...362 stellite ich hier ein Schiffhausen auf 5000 zu. Du gehst bis Ende Piste und dann geht Du nach Schaffhausen und bist auf Nummer 2.)

FP ...la visibilità quanto è?

(AP wieviel beträgt die Sicht?)

FP La visibilità è 9 kilometri.

(AP Die Sicht ist 9 Kilometer)

FP Pailento a 250

(AP ich verlangsamen auf 250)

FP Bravo.

FP Piacere oggetto duo.

(AP Machen wir Kategorie zwei)

FP Si perché là dobbiamo provare.

(AP weil wir es ausprobieren müssen)

FP ...allora altra qua...

(AP ...altra sette ich hier...)

FP Questo l’accetta la categoria duo? Si/

(AP akzeptiert dieser die Kategorie zwei ja?)

FP Naturali lo minima di cat duo?

(AP setzen wir die Kategorie zwei Minima?)

FP Dobbiamo provare il...95.

(AP wir müssen den...95 versuchen)

FP 95

FP Allora quanto è? 95?

(AP wieviel ist CQ? 95?)

AP No io leggo 55...95...95

(AP rein ich lese 95...95...95)
Abbiamo guardato la gamba piatta si?
(Haben wir die gleiche Piastre angesehen, ja?)

No.

(Ah, da hast du's!) (wie ist der Durchgang?)

La ristattata per gira a sinistra per Schaffhausen.

(Der Durchgang dreht dann links nach Schaffhausen)

Ah eno perché non c'è d'accordo su quello
che dovete andare che ci vai a fare sul beacon...
...stessa pasto...

(Ach ne, das ist es wahr, Du mir nicht
einig warst, aber was machst Du auf dem
beacon...giachhe Piaste...)

Sorvita poi un'altra volta.

(es wird für ein anderes Mal dionen)

Vi bene l'importante...

(Gut, das Wichtig...)

...

Ach...

...e che poi mi capisca. Quando tu non sei
d'accordo...io l'ho detto non ci andare su
quel beacon...vedi direttamente a sinistra,
vdi l'avev messo...

(Ist es am Schuss, dass man versteht. Wann
Du nicht einverstanden bist...ich hatte Dir
gesagt, ich nicht auf den Beacon...geh direkt
links, siehst Du ich hatte mir gesagt...)

...io ti ho detto due volte perché, tu mi hai
detto perché tanto vedi la fine piasta...

(Ich habe es Dir zweimal gesagt warum, Du
hast mir gesagt, Du siehst...wischen das Fin-
fenende.)

Sì...su quest'altra è obbligatorio andare
chi a obbligatorio andate perché qui ci
sta una fonte di 1677 piedi vedi è alta sui
quelle.

(Um mein bei dieser anderen ist es obliga-
torisch dorthin zu gehen ein! Hier ist es ob-
ligatorisch dorthin zu gehen, weil hier eine
Spitze von 1677 Fuß besteht, siehst Du die
ist hoch.)

19:00:50 AVK A2A604 turn right heading 340
19:01:00 AP Right 360 A2A604
AP Quando...non sei d'accordo?

(wenn...hast Du nicht einverstanden?)
AP Sosia se forza non ha capito io ma perché
mi dici così tu ero convinto che, che tu
m'avesse detto perché...mi dici di mettere
Wallisellen...
(Escludibile quando non vi delitto non vor-
stande habt... aber da Di mir so sagt, war
ich überzeugt, dass Du mir darum gesagt hät-
test...Du sagt mir Wallisellen zu setzen.)
FP eh...
AP Porò non è vitale è importante perché mi dici
quando c'hai quel valore di Wallisellen gira
a sinistra... capisci invece quella altra dice
no, vai diritto proprio su Wallisellen...an
giar chiarette eh oh perché...
(Aber du ist nicht lebenswichtig, es ist
nicht wichtig, weil Du mir sagst, wenn Du
den Wert von Wallisellen hast, drehe
links... verstehst Du, der Andere sagt aber,
nein, genau gerade aus, genau auf Wallisellen...
nein um klarzustellen, ich möchte es klar-
zustellen, eh oh weil sonst)
AP Siamo ai traverso di fronte a livello 90 per
ci si porta alti oh
(Wir sind querab von Kloten auf Flugfläche 90
er bringt uns hoch)
FP Siamo alti acco questo...
(Wir sind hoch, so dicsor...)
AP Intendi lo deccelerare ancora di più perché
superato il traverso è molto carico, più
corti più (allontano capitò) e se più (allon-
tanti le minimo la salgono).
(Also doch, ich würde noch langsamer fliegen,
weil, sobald wir "querab" durchqueren haben,
ist es unmöglich zu reihen, jo schneller Du
bist, unsomehr entfernt Du Dich und die Min
desthöhen steigen.)
FP...svolta....
(...Jetzt...)
AP Tanto sta ai traverso...più vai piano e meno
lento impugna per l'alterazione.
(Du bist sowieso querab...je langsamer Du
gehst umso weniger lang hast Du zur Landung.)
ATC ASA 406 reduce to 210 knots
19:02:10 AP 210 knots reducing 404
THROTTLES TIER SOUND
AP Hei visto?
(Hast Du gesehen?)
ATC ASA 404 desend to FL 60
19:02:30 AP  VOMIT 60 AZA 404
THROTTLE IDLE SOUND
19:02:50 ATC  AZA 404 turn left heading 325 again
TRIM
AP  Consigliò ridurre a 200 nodi, pure sa che tanto è niente corretti siamo gia 15 miglia out.
(Tech empfahl, reduzieren auf 200 Knoten auch
Du er hat sowieso keinen Sinn zu presenieren.
Wir sind schon 15 Meilen out.)
CLICK CLICK
FP  ...andiamo verso l'orizzonte... facciamo...
(Richtung Horizont... machen wir...)
FP  ...mette l'ingresso 068 per andare...
(...ich setze den inbound 068 um zu gehen...)
TRIM
FP  49 ...69...
AP  Ci sono novi gradi. Quindi non ci occorre
l'antiquariato qui, sto alla limite... abbiamo
ci sono 6 gradi.
(Es ist neun Grad. So brechen wir nicht die
Festung hier. Wir sind an der Grenze...)
ALTITUDE ALERT SOUND
AP  L'altimetro è a 1200 determinabile anche
di 1,8 da Kilo. Rhine 5.6...
(Der Guter Marker ist auf 1200 die auch durch
5,8 von Kilo werden können Rhein 5,6...)
19:05:15 ATC  Lufthansa 1834 zurich Arrival good evening
stand by. Break break. AZA 404 turn right
heading 070.
19:05:20 AP  Right 070 AZA 404
CLICK
TRIM
AIRLINE CODE
AP  India Kilo Lima
19:06:20 AKH  AZA 404 descend to 4000 feet. turn right-heading 110. cleared ILS approach runway 14,
QNH 1019.
19:06:30 AP 1070 4000 feet, turn right heading 120 to intercept runway 14
ATC Maintain 210 404
AP Two ten maintaining

CLICK CLICK

19:06:45 AP ...altimetry 1 - 9 e...7.
19:06:50 FP 1979
AP Quant'è allora?
(Wieviel ist es also?)
19:06:55 VP 470 l'ho guardata in...
(970 ich habe nachgeschaut.)
19:07:05 AP ...bene 970 va bene. Landing data 37 125 sulla salmone va bene. La riattraccate a memoria.
(...Gut 970 es ist gut. Landing data 37 125 auf dem Zeiger. Es ist gut. Den Durchstart auswendig.)
19:07:10 FP 27 40 doppi 128 Schaffhausen
(37 40 doppi 138 Schaffhausen)
AP Perfetto.
(Fürkelt)
1F ...5000 sul duc
(... 5000 auf dem zwei)
19:07:20 FP Cosa ha detto? 110?
(Was hat er gesagt? 110?)
AP (contemporaneamente) 10 zulgo tutto
(10 Ich nehme alles weg)

CLICK CLICK

FP Autorizzati a seguire?
(Freigabe um zu folgen)
19:07:25 AP Autorizzato fino a 4000 piedi dopo di che a intercettare e seguire.
(Freigabe bis 4000 Puss, nach dem Aufzählen und folgen)
VP ...alora facciamo Radio Approach.
(... Dann machen wir Radio Approach)
AV Vai.
(Gohe)
ATC AAA 404 reduce to 180
19:07:40 AV Reducing now 180 404
19:07:45 AP ...se i'hai tu qui il glide?
(Hast Du ihn hier den Glide?)
...su una nav... de l'bu
(...Auch oben, nein (nicht)... habe ich es)

Benissimo, allora lo facciamo sull'uno
(Sehr gut, dann machen wir es auf dem eins)
Radio eins

Flaps

Riduci un minima la velocità...
(Reduzioni ein bisschen die Geschwindigkeit)

TAP TAP TAP

ATC A3A 404 reduce lo 360 kts.

AP Reducing 160

AP ... Capture loc capture glide path capture, quindi siamo nel tondo collocato ad po aposta a ma.
(Wir sind also im eingefangenen Strahl etwas verschoben aber...)

FP Neve sotto zero anche io.
(nein sieben null auch ich)

AP Altitude WARNING SOUND

19:09:01 AP 160.

19:09:09 AP Cancello e scrivi 5000
(ich lösche und setze 5000)

[GRAN DOWN?]

TRM

19:09:18 AP Ce ne abbiamo uno un'altra davanti abbastanza vicino, Metti anche 250 se no ve a finire che schiamiamo no la rialeccata.
(Wir haben einen vorne, ziemlich nahe ..., Setze auch 150 wenn geht es noch so weit, dass sie uns einen Durchstab aufwirbeln.)

19:09:33 FP Ci'è ghiaccio?
(Rot an Eis?)

19:09:35 AP No no, praticamente no, o'abbiamo 10 gradi e 10 in terra.
(Noin nein, praktisch nicht, wir haben 10 Grad und 10 am Boden)

19:09:41 FP Flaps 25.

AP Flaps 25.
19:09:47 AP  Check dell' Outer Marker è 1250 piedi
                      [Der Outer Marker Check ist auf 1250 Fuß]
FP  Flaps fifty mettissimo...123
19:09:52 AP  Bravo

CLICK

19:10:12 AP  ...3.8, quatt 4 miglia
                      (...3.8 fast 4 Meilen)
19:10:27 PP  ...Non è passato...?
                      (...)ist er noch nicht vorbei...
19:10:39 PP  Non è passato l'outer marker?
                      [Ist der outer Marker noch nicht vorbei?]
AP  No, no, non ha cambiato...oh, qui mi da 7...
                     (Nein, nein, hat nicht gewechselt...oh, hier
                     gibt es mir?)
19:10:50 ATC  MAP 404 speed now as convenient 4 miles
                      behind a DC9 contact Tower eighteen one
                      Good night.
                     [VIR! good bye.

FREQUENCY CHANGE

19:10:55 AP  ...che cosa su torini...
                      (...das hat für mich keinen Sinn...)
PP  No meanche a me.
                     (Nein, mir auch nicht)
19:10:57 AP  Tira su, tira su, tira su, tira su!
                      [Siehe, siehe, siehe, siehe]

CLICK

19:10:59 PP  Oh around
19:11:00 AP  No, no, no, no (fattidi!) (I glide
                      (Nein, nein, nein, nein, ?packen den Gleide)
19:11:11 AP  Ce la fai a toggeria?
                      [Kannst Du ihm helfen?]
19:11:13 PP  Sì.
                      (Ja.)
19:11:14 PIP PIP PIP PIP PIP PIP PIP PIP PIP PIP PIP
19:11:16 AP  Aspetta proviamo a rin...
                      [Warte, versuchen wir zu blie...]
19:11:18 CRASH

* phonetically, nicht genau definiert.
Anzug aus dem DFDR der AZ 404 vom 14.11.1990 (1905:00-1911:18)
Estratto delle registrazioni del DFDR del volo AZ 404 del 14.11.1990 (1905:00-1911:18)
Extract of DFDR of AZ 404, 14.11.1990 (1905:00-1911:18)
Beilage / Annesso / Annex 8

Bildliche Darstellung der Arbeitsweise des „Comparator“ mit dem Radio switch in Stellung APPROACH (Comparator in Betrieb)
Rappresentazione grafica del funzionamento del “comparatore” con il selettore radio in posizione APP (comparatore attivato)
Pictoral presentation of “comparator” operation with Radio switch selected to APP (comparator active)
Bildliche Darstellung der Arbeitsweise des „Comparator“ mit dem Radio switch in Stellung I (Comparator ausser Betrieb)
Rappresentazione grafica del funzionamento del “comparatore” con il selettore radio in posizione 1 (comparatore disattivato)
Pictoral presentation of “comparator” operation with Radio switch selected to 1 (comparator not active)
Beilage / Annesso / Annex 10

Instrumenten Anflug- und Landekarte aus AIP Schweiz
Carta d’avvicinamento e atterraggio strumentale dall’AIP Svizzera
Instrument approach and landing chart from AIP Switzerland
Beilage / Annesso / Annex 11

Instrumenten Anflug- und Landekarte aus Alitalia Route Manual
Carta d’avvicinamento e atterraggio strumentale dal manuale di rotta Alitalia
Instrument approach chart from Alitalia Route Manual
ZURICH, SWITZERLAND
ZURICH AIRPORT

ILS RWY 14

1416

VAR. I - W

CIRCLING AREA

MISSED APPROACH
On 138° to D-2/1-KL 172° WAL
NDB (NDB) or 218° (BBB) whichever is
later turn left to SHA NDB climbing
to 9000 (3000). Max IAS 210
during turn.
ARRIVAL INFO

ATIS – TWA 1143 – 128.52 020/2200t (S) 0320/2300t (W)

SPEED RESTRICTIONS
Max IAS 250 Kts below FL 100, if not otherwise instructed. Assigned speeds shall be maintained after during intermediate approach if unable to inform. AIC to ZURICH APT shall be flown at IAS 250 Kts or less when within DME 60 TWA arc. IEME TWAUS, DME 60 Kt/Leg arc to be in ond. Flights unable to comply with this speed limit, they shall fly the minimum speed acceptable.

NOISE ABATEMENT
1. Normally all landings shall be made on RWYs 16 and 14, other runways may only be used if landing on RWYs 16 and 14 is unworkable due to technical or meteorological reasons. Proceed circling visual right or left hand for landing on RWY 28 or left hand for RWY 10. RWY 32 and 34 are not available for landing.
2. Fly visual circuits at 3000 or higher and avoid flying over the adjacent communities unless possible.
3. Reverse thrust: do not use more than ida reverse if possible.
4. Auxiliary Power Units (APU)
   After arrival, APU shall not last more than 20 mins. In special cases, the Airport Authority may permit longer use.
   The use of these units for maintenance reasons shall be minimized.
5. Night flight restrictions
5.1 Landings not systematically granted between 2000/0400 (S) – 2100/0500 (W)
5.2 Scheduled a/c (including supplementary flights and rerouted flights but excluding alternate landings):
   - Landings until 2200 (S) – 2300 (W) will be authorized by F.O.C.A. (Federal Office for Civil Aviation).
   - In case of delay till 2230 (S) – 2330 (W) without special permission. Supplementary landings till 2200 (S) – 2300 (W) can be authorized by F.O.C.A. upon request.
   - Landings between 2230 and 0030 (S) and 2330 and 0400 (W) can be authorized by F.O.C.A. for important reasons.
   - Pilots can only expect to receive a clearance for approach if he is over or above (when radar vectored) reporting points SHN NDB or EKOH VFR at 2230 (S) – 2300 (W) at the latest.
5.2.2 Non-scheduled a/c:
   - Landings between 2000 and 2100 (S) – 2100 and 2200 (W) are subject to an authorization. In case of delay authorized night flights will be admitted only till 2130 (S) – 2230 (W).
   - Landings between 2130 and 0400 (S) – 2330 and 0500 (W) can be authorized by F.O.C.A. for important reasons.
   - Pilots can only expect to receive a clearance for approach if he is over or above (when radar vectored) reporting points SHN NDB or EKOH at 2130 (S) – 2250 (W) at the latest.

TAXI PROCEDURES – See GHI Movement Chart

- A/c shall contact ZURICH APT before following instructions from ZURICH TWR or "QUICK CONTROL" and shall taxi independently to their parking positions as instructed by "ZURICH APT".
- If, while taxiing into a dock-parking position, the crew notices that the docking guidance system has not been put into operation or is otherwise unserviceable they shall stop the A/C immediately.
- The unserviceability has to be notified, on the Aeronautical frequency. The A/C shall not taxi any further, until a "Follow-me" car is taken over the guidance.

ARRIVAL INFO

system has not been put into operation or is otherwise unserviceable they shall stop the A/C immediately.
- The unserviceability has to be notified, on the Apron Control frequency. The A/C shall not taxi any further, until a "Follow-me" car is taken over the guidance.

RUN-UP
Run-ups are authorized from 0500/1000, duration and power settings for each run-ups shall be kept at a minimum. For safety reasons and noise monitoring, the running of engines, not used for taxing out, is subject to prior permission, to be requested from ZURICH APT on 121.75.

PARKING PROCEDURES

Guidance of a/c on Apron: (See GHI Movement Chart)
Visual docking guidance system available.
- ASIS/Stopping position indicator at Dock Terminal "B" (See Aerodrome Info)
- SAFEGATE for stands at Dock Terminal "A" (See Aerodrome Info).
- In exceptional operational conditions "Follow me" cars are available for a/c guidance.
- For parking at self-manoeuvring parking stands
   directional guidance is acceptable, follows own respective a/c F.T. time, when your CoP coincides with yellow STOP line on your left side.
   - Distance for taxi onto stands DCS: follow (dashed) standline with 0 in front of stand number A300DC10: Follow (solid) standline with 1 in front of stand number B747: Follow (solid) standline with 2 in front of stand number.

OTHER INFORMATION

1. Reduction of separation minima between landing a/c on Rwy 14 & 16.
   A clearance to land must be issued to arriving a/c provided the following the proceeding landing a/c has crossed the TWR and passed beyond a point at least 2500 m from the TWR and in the movement.

   Conditions for application:
   a) Full landing distance available.
   b) A/C concerned operating normally.
   c) By day only and visibility at 8 Km or above.
   d) No turbulence or windhear is known.
   e) Runway is in dry condition.
   f) Presence of "A2 400 cleaned to land, DCS short to clear the runway".
   g) RWY 16 ground except last 400 m.
   h) ASIS available; "APRON CONTROL" info and flash through TWR and "QUICK CTL"

CAT III APPROACHES
(During CAT III weather conditions the approach will be radar-vectored alternatively from SHN NDB to Rwy 16 and from EKOH to Rwy 14)
Approach -lighting system and runway lights Rwy 14 and 16 are fully operating simultaneously.

WARNING: Do not mistake Rwy 14 for Rwy 16 in rapidly changing weather conditions.

COMMUNICATION FAILURE
ICAO basic proc. and in addition.

Proceed via the appropriate inbound route to either EKOH RP or SHN NDB. At right hand E'TA commence descent in the holding pattern and carry out a standard instrument approach.
Beilage / Annesso / Annex 12

Sicherheitsempfehlungen des NTSB
Raccomandazione dell’NTSB
NTSB Safety recommendations
On November 14, 1990, a McDonnell Douglas DC-9-32, registered in Italy as I-ATJM and operated as Alitalia flight 404, (ATA 404) crashed into the side of a mountain about 5 miles north of Zurich-Kloten Airport (LSZH). The flight had departed Milano-Linate Airport (LIML) at 1936. The accident occurred at 2013, during an instrument landing system (ILS) approach to runway 14 at LSGI. The captain, first officer, 4 flight attendants, and 40 passengers perished. The accident is under investigation by the Swiss Federal Aircraft Accident Investigation Bureau, and the National Transportation Safety Board, the Federal Aviation Administration (FAA), and Douglas Aircraft Company are participants in accordance with the provisions of the International Convention on Civil Aviation.

Details of the accident sequence of events and conclusions will be forthcoming when the Swiss Government publishes the report in March, 1992. The investigation has disclosed a possible failure mode of the very high frequency omnidirectional range (VOR)/ILS system, which was installed on the airplane, that could have contributed to this controlled flight into terrain. This failure mode could have led the flightcrew into believing they were on course and on the glidepath when they were not.

According to Douglas Aircraft Company engineers, it is possible that a short circuit in the navigation instrumentation or a radio receiver in the aircraft's VOR/ILS receiver could cause the instrument to indicate zero deviation. Thus, raw data deviation information on the attitude direction indicator, displayed by the flight director bars, and the horizontal situational indicator could center and remain centered with no failure or warning flag in view. In addition, this short circuit or open circuit could prevent the autopilot and the ground.

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1All times are Zurch local time (UTC+1 hour).
proximity warning system (GPWS) from receiving the proper course and glideslope deviation signals. The autopilot would continue to guide the airplane according to previously established course inputs, and the GPWS would not sound an alarm due to glideslope deviation or descend below a safe altitude. This could also occur if the VOR localiser (LOC) or glideslope signals to the autopilot were interrupted by an open circuit.

As a crosscheck of the system, the captain and first officer would normally use two separate VOR/ILS receivers for navigation information that would be displayed on their respective instruments. However, without warning flags indicating system failure, the pilots might accept as accurate centered indications and then use the 'NAV' switching function to select the malfunctioning VOR/LOC receiver on both panels. According to Douglas, some VOR/ILS receivers have an expanded self-monitoring capability to detect this type of failure. Receivers that do not have this feature are:

- Collins model 51RV-1
- Collins model 51RV-4
- Wilcox model 605
- King model KNR6030
- Bandix model RNA 26C (some versions)

Douglas issued two All Operators Letters (AOLs) [AOL No. C-1606-2HK-1134, dated July 27, 1984, and AOL No. 9-1565, dated August 24, 1984] that described the potentially hazardous failure modes. The company issued another All Operators Letter (Douglas AOL No. C-11-2LO-1001-01-A001) on March 3, 1984, following this accident that reiterated the information in the 1984 letters. According to Douglas records, Altavilla received the 1984 letters and other information relating to the anomaly in 1984. Altavilla pilots, however, were unaware of the potential problem until after the accident.

Douglas Aircraft Company revised DC-9 and MD-80 Flightcrew operating manuals to reflect the possibility of short or open circuits within the VOR/ILS system. Douglas officials also believe that the failure scenario should be incorporated into all DC-9/MD-80 flightcrew training curricula. The Safety Board believes that this action is appropriate. Douglas officials are recommending that if a discrepancy exists between deviations displayed on the indicators of the same type of instrument, the pilots should carefully compare the VOR/LOC or glideslope deviation information with other navigational aids, such as distance measuring equipment, VOR bearing, radio and barometric altitude, marker beacon, automatic direction finder bearing, and vertical speed. Also, if 'NAV' switching is used, it should be accomplished before localizer and glideslope capture on an instrument approach to allow positive verification of all deviation information that will be used for that approach. Douglas further recommends that if one VOR/ILS receiver is inoperative, the other receiver should be temporarily tuned to a nearby VOR station and the selected course varied to ensure that the course deviation indicator moves in accordance with the selected course.
These VOR/ILS receivers may also be installed in an undetermined number of air carrier and other aircraft made by U.S. and other manufacturers. The Safety Board has no reasonable means to determine what other types of airplanes utilize these receivers or what companies operate these airplanes. However, because these VOR/ILS receivers may also be installed in some corporate or other general aviation aircraft, the Safety Board believes that information regarding this potential problem should be published in Advisory Circular (AC) 43-16, General Aviation Airworthiness Alerts, in addition to being disseminated to all air carriers.

In view of the findings, the Safety Board recommends that the Federal Aviation Administration:

Issue an Air Carrier Operations Bulletin to Principal Operations Inspectors requiring that operators of airplanes equipped with the following navigation receivers include in their Pilot Operating Manual's procedures for detecting malfunctions that result in the display of disparate information: Collins model SIRV-1; Collins model SIRV-4; Wilcox model 806; King model KNRC030; and some versions of Hendix model RKA 266. Also, notify formally foreign airworthiness authorities about the potential failure modes in such equipment. (Class II, Priority Action) (A-92-8)

Publish the substance of this recommendation in Advisory Circular (AC) 43-16, General Aviation Airworthiness Alerts. (Class II, Priority Action) (A-92-9)

Chairman KOLSTAD, Vice Chairman COUGHLIN, and Members LAUBER, HART, and HAMMERSCHMIDT, concurred in these recommendations.
Beilage / Annesso / Annex 13

Instrumenten-Anzeigen, Stellung des Radio-Schalters und Anzeigen des „Mode Annunciator“ und des „Bow Tie indicator“ im Cockpit der AZ 404

Indicazioni degli strumenti, Posizione dell’interrutore Radio e indicazioni del „Mode annunciator“ e del „Bow Tie indicator“ nel cockpit del volo AZ 404

Instrument indications, Radio switch position and indication of mode annunciator and Bow Tie in the AZ 404 cockpit
Cockpit Voice Recorder

1906.20 APP A3A 494 descend to 4000', turn right HDG 110, cleared ILS approach runway 14, QNH 1019.
1906.30 404 1019. 4000', turn right 120 to intercept runway 14.
APP Maintain 210. 404.
404 Two ten maintaining.

- Switching is heard -

1906.45 A/P ..altimeters 1-9...67
1906.50 P/P 2019
A/P What is it?
1906.55 P/P 970 I checked it
A/P Good 970 it's OK. Landing Data 37 126 on the end ...or, the sounds by heat.
P/P 37 40 at the 'Double Bags'.

1907.05 A/P Perfect.
1907.10 P/P ..5000...on 2...
Cockpit Indications

Geographical Situation

A/C Configuration:
- Gear up
- Flaps in
- IAS 212

Cockpit Voice Recorder

2000.20 APP AOA 404 descended to 3000, turn right VMO 110, cleared the approach runway 16, 404 HSI.
2104.10 404 1019, 4000', turn right 120 to intercept runway 16.
APP Maintain 210, 404.
H/T Two ten maintaining

- Switching is heard -

1936.45 APP ...inverted 1...67
1936.55 F/P 1019
A/P What is it?

1936.65 F/P PT0 I checked it
A/P Good 950 to the CT. Landing gear 29 145 on the red bug on the threshold box.

1936.55 F/P 50 40 at the 'Double Bear',

1936.15 A/P 103 'This is a test'.
A/P Perfect
F/P ...400' 66.2
Cockpit Indications

Geographical Situation

A/C Configuration:
- Gear up
- Slats out
- Flaps 5
- IAS 210

Cockpit Voice Recorder

14:57:24 A/P Good 390 ILA ok, landing data 29° 31° on the
14:57:25 F/T 17 alt at the 'Double Berg',
14:57:26 A/F Schaffhausen
14:57:27 F/T ...5000 on 2
14:57:28 F/T 17 4k3 he say? 110?

(A/Simultaneously the A/P says)
14:57:29 A/P 18. everything good (auto sound)
14:57:30 F/T Are we cleared for approach?
14:57:31 A/F Cleared 3000 4900, afterwards to intercept to holding.
14:57:32 F/T ...to be a jet radio Approach

AUTOFILM ALERT SOUNDS

14:57:33 A/P Go
14:57:34 APP ASA 434 reduce to 140
14:57:35 F/T Reducing 343 IAS, 434.
Cockpit Indications

Geographical Situation

AC Configuration:
- Gear up
- Slats out
- Flaps 5'
- IAS 210

Cockpit Voice Recorder

1407.45 FLT 404 Returning 45 clock 404.
(next portion barely understandable)
1407.45 F/P ...Do you have the glide?
1407.52 A/F ...on the 1
1407.57 F/P I don't... beat it.
Cockpit Indications

Geographical Situation

AC Configuration:
Gear up
Slats out
Flaps 7'
IAS 265

Cockpit Voice Recorder

(Next portion barely readable)
1927.43 F/F  ...do you have the flaps?
1927.44 A/P  ...and the flaps?
1927.45 F/F  ...I don't... bank it!
1927.46 A/P  Great, so let's do it on 150.
1927.47 F/F  Radio 1 (onset)
Cockpit Indications

Geographical Situation

A/C Configuration:
- Gear up
- Flaps 15
- IAS 175

Cockpit Voice Recorder

1005.17 VHF Flight...
1005.20 A/P Reduce the speed a little
TAPPING NOISE (perhaps indicating something)
1005.25 VHF FL 240 reduce to 100 knot
1005.30 VHF Peeling up...
1005.43 VHF ...continue LOC capture glide path capture...
Cockpit Indications

Geographical Situation

AC Configuration:
- Gear up
- Slats out
- Flaps 15
- IAS 174

Cockpit Voice Recorder

1946.58 - ALTITUDE ALERT SOUNDS (3700' descending) -
Cockpit Voice Recorder

1907.18 A/P: ALTITUDE ALERT SOUNDED (2700' descending)
1908.01 A/P: 15'
1908.03 A/P: I need you to check 2000'
1908.10 A/P: Change of noise heard (could indicate gear extension).
1908.19 A/P: There is another 2000 in front quite close. You can see when further to the Southwest we'll end up with a go around.
1908.25 P/T: Is there some fire?
1908.28 A/P: No 20. If ever we have 10 degrees and 10 degrees on the ground.
1908.31 P/T: Flaps twenty four.
1908.42 A/P: Flaps twenty four (no gear warning.)
1909.07 A/P: Outer Marker check is at 1200'.
1909.47 P/T: Flaps fifty feet set...1111.
1909.52 A/P: Bravo

- Switching is heard (could be the final check) -
Cockpit Indications

Geographical Situation

A/C Configuration:
Gear down
Slats out
Flaps 50
IAS 156

Cockpit Voice Recorder

- Switching is heard - (could be the final check?)

1910:12 A/P ...3.8 statute miles
1910:17 F/O ...Did we pass it...
1910:18 F/O ...Did we pass the target marker?
A/P ...No it hasn't been passed yet...
Cockpit Indications

Geographical Situation

AC Configuration:
- Gear down
- Slats out
- Flaps 50
- IAS 198

Cockpit Voice Recorder

1310.45 ARP  Oh, is there 7 (Miles, maybe starting a cross check)
APP  ATC, we can speed now as convenient, 4 miles behind a DC-9, contact them also. Good night.
1310.56  454  114.1 Good Night
1310.55  Frp  That doesn't make sense to me...
ARP  Mention...
Cockpit Indications

Geographical Situation

A/C Configuration:
- Gear down
- Slats out
- Flaps 30
- IAS 132

Cockpit Voice Recorder

1400.38 P/F: ...It's just not making sense to me...
A/P: Not to me...
1400.37 A/P: Pull, pull, pull pull
- Click of Auto-pilot disengagement heard
1400.38 P/F: ...ARGON...
Cockpit Indications

Geographical Situation

A/C Configuration:
- Gear down
- Slats out
- Flaps 30
- (AS 135)

Cockpit Voice Recorder

1110.59 AP: Oh, my god...
1111.00 AP: ...This is my... Do not ask for the slide...
1111.12 AP: Can you hold it?
1111.13 AP: Yes
1111.14 - pip pip pip pip pip (radio altimeter passing 2000')
1111.15 AP: Hold on, let's try to put uh...
1111.18 - Crash sounds heard -
Graphical flight path presentation of AZ 404 with continued go around after time 19:10:59
Beilage / Annesso / Annex 15

Von ALITALIA getroffene Massnahmen
Provvedimenti presi dall’ALITALIA
Measures taken by ALITALIA
Federal Aircraft Accident Investigation Commission
Bern/ Switzerland

Dear Sir,

we respond to your request concerning our actions taken in the interest of future safety.

1. Technical / Maintenance
   - Introduction of MARK VII GPWS, with automatic callout of altitudes during approach. This program started on DC-9 and concerns the whole fleet to achieve a standardisation to the MD-11 status.
   - A special task force has been set up in order to monitor more strictly the reliability of Navigation Systems.
   - Introduction of automatic test procedures for the Switching Box.
   - New restrictions concerning the consequences of any swapping of suspect devices within or between M/C.

Roma, 11.5.1992
2. Operational

- DC-9 Operational Bulletins concerning “Possible VOR/ILS Failure Mode” (last issue 18 October 1991). Similar Bulletins were issued also for MD-80, A300 and B747.

- Amendment to DC-9 Operations Manual (25 May 1991) concerning the setting of the radar altimeter “selected height bug” in order to further increase crew awareness about terrain proximity. Similar amendments were issued also for MD-80, A300 and B747.

- Several amendments to the Manuale Operativo (Company Procedures Manual) concerning callout's and go-around procedures.

3. Training

- Modification of the DC-9 transition course. It now contains extensive coverage of possible VOR/ILS failure modes.

- Modification of the simulator expanding the capability to show detrimental VOR/ILS indications beyond the previous level.
Vom BAZL getroffene Massnahmen
Provvedimenti presi dall’UFAC
Measures taken by FOCA
Unfallflugzeug DZ.404 vom 14.11.1990; Zusammenfassung der getroffenen Maßnahmen.

1. Weisung an die Flugverkehrspiloten, die Fluggäste bis zur Meldung "established in the Rahmen des "monitoring" zu überwachen.


3. Handelsbeauftragung auf dem Staldenberg wird erstellt.


BUNDESAMT FÜR ZIVILFLUGFAHRT
Selbst Flug sicherung

(Englischer Text siehe Rückseite)
1. Instructions to the Air Traffic Controllers to include Flight Altitude in their monitoring until the "established" report.

2. Examine the feasibility of Angle of Approach lighting on Instrument Landing Runways in Switzerland; first results indicate problems. Detailed examination now in progress.

3. Obstacle lighting on the Stadelberg will be built.

4. Revision of the AFC Manuals 1 and 2 is in hand. Completion in 1993.

5. A "Minimum Safe Altitude Warning" System (MSAW) will be acquired and should be in service in the first quarter 1993.

6. Instructions concerning the suspension of approach aids after an accident.

7. Instructions concerning the viewing of the data sources (Radio, FANOMOS, Radio, connections) after an accident.

8. Instructions concerning the cooperation of Swisscontrol employees with the BPU after accidents.

9. Enabling the recording on the same tape of all communications relevant to the work stations.

FEDERAL OFFICE OF CIVIL AVIATION
Air Traffic Control Section