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Confédération suisse  
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Swiss Confederation

Schweizerische Unfalluntersuchungsstelle SUST  
Service d'enquête suisse sur les accidents SESA  
Servizio d'inchiesta svizzero sugli infortuni SISI  
Swiss Accident Investigation Board SAIB

Aviation Division

# **Final Report No. 2128 by the Swiss Accident Investigation Board SAIB**

concerning the serious incident  
(AIRPROX)

involving a Hawker 4000, registration  
M-KENF

and a Mirage III DS, registration  
HB-RDF, callsign EMIR12,

on 31 August 2010

at SOSAL, 17 km north of Montreux

## General remarks concerning this report

This report contains the Swiss Accident Investigations Board's (SAIB) conclusions on the circumstances and causes of the accident/serious incident which is the subject of the investigation.

In accordance with art 3.1 of the 10<sup>th</sup> edition, applicable from 18 November 2010, of Annex 13 to the Convention on International Civil Aviation of 7 December 1944 and article 24 of the Federal Air Navigation Act, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the incident investigation. It is therefore not the purpose of this investigation to determine blame or clarify questions of liability

If this report is used for purposes other than accident prevention, due consideration shall be given to this circumstance.

The definitive version of this report is the original in the French language

All times in this report, unless otherwise indicated, are stated in local time (LT). At the time of the accident, Central European Summer Time (CEST) applied as local time in Switzerland. The relation between LT, CEST and UTC is:  $LT = CEST = UTC + 2 \text{ hours}$

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## Final report

### Synopsis

#### M-KENF

Owner	Avalanche Aviation Ltd., Hamilton, Bermuda
Operator	Global Jet, L-1030 Luxembourg
Constructor	Hawker Beechcraft Corporation, Wichita, Kansas, USA
Aircraft type	Hawker 4000
Country of registration	Isle of Man
Registration	M KENF
Flight rules	IFR
Type of operation	Private flight
Departure point	Geneva LSGG
Destination point	Zurich LSZH

#### EMIR 12

Owner	Fondation du Musée Militaire de l'Aviation Militaire de Payerne, Switzerland
Operator	Espace Passion, Airbase, CH-1530 Payerne, Switzerland
Constructor	Avions Marcel Dassault-Breguet Aviation, France
Aircraft type	Mirage III DS
Country of registration	Switzerland
Registration	HB - RDF
Call sign	Emir 12
Flight rules	VFR
Type of operation	Private flight
Departure point	Payerne LSMP
Destination point	Payerne LSMP
Location	Near waypoint SOSAL SOSAL 46 33 29 N, 006 53 04 E
Date and time	31 August 2010, 09: 22 UTC
ATS units	Geneva ACC sector INI South/East Payerne Radar (PAY), position MM2
Airspace	Class C

## Investigation

The serious incident occurred on 31 August 2010 at 09:22 UTC and was notified on 2 September 2010 at 13:09 UTC to the Federal Aircraft Accident Investigation Bureau (AAIB). After gathering pertinent information on the case, the AAIB opened an investigation on 8 September 2010 at 16:18 UTC.

The AAIB notified the incident to the authorities of Great Britain, the Isle of Man and Luxembourg.

The investigation report is published by the Swiss Accident Investigation Board.

## Summary

The incident was caused by the dangerous convergence of a Hawker 4000 crossing on ATS route N871 and a demilitarised Mirage III DS in civil operation heading for the Payerne military air base to carry out an emergency landing exercise in case of engine failure. The aircraft involved in the conflict were being handled by air traffic controllers assigned to two different sectors, one civil and one military.

In the climb phase, the pilot of the Mirage III DS exceeded his cleared flight level and converged on the Hawker 4000, which crossed 1000 feet higher.

## Cause

The incident is due to the fact that a pilot of a VFR flight adopted an excessive rate of climb in controlled civil airspace and that the aircraft overshot the assigned flight level, causing a dangerous convergence with an aircraft operating under instrument flight rules.

## Safety recommendation(s)

The report generated one safety recommendation.

## 0 Foreword

On 19 November 2008, an airprox incident involving an Airbus A320 and a military formation of two F/A-18 Hornet fighters took place at the same place and in an air traffic control configuration identical to that in which the dangerous convergence which is the subject of this investigation occurred. It gave rise to investigation report No. 2099, in which the basic information common to both events was recounted.

## 1 Factual information

### 1.1 History of the serious incident

#### 1.1.1 General

The history of the incident was established using the recordings of the radar plots, transcripts of the radiotelephony communications between the flight crew of aircraft M-KENF and sector INI South/East of Geneva Area Control Centre (ACC), those of the pilot of the Mirage III DS and of the military "Payerne Radar" sector, as well as those of the telephone coordinations between sector INI South/East and "Payerne Radar". It is based on the testimony and incident reports of the air traffic controllers and pilots involved.

#### 1.1.2 Flight rules and areas of responsibility

The incident occurred in class C airspace. *IFR and VFR flights are permitted in this airspace, an air traffic control service is provided to all flights and separation is ensured between IFR flights and between IFR and VFR flights. VFR flights are separated from IFR flights ...* Ref. ICAO Doc 9713, C182.

#### **CLASS C**

*In airspace class C:*

*IFR and VFR flights are permitted;*

*All flights are provided with air traffic control service;*

*Note: This means that both IFR and VFR flights are subject to an ATC clearance when flying in airspace class C.*

*IFR flights are separated from other IFR flights and from VFR flights;*

*VFR flights are separated from IFR flights (...)*

*VFR flights may be cleared at IFR levels*

Ref.: ATMM CH Section 4 Infrastructure and Navigation

Flight M-KENF was flying according to instrument flight rules (IFR) and was controlled by sector INI South/East. The Mirage III DS was flying according to visual flight rules (VFR) and was being handled the military sector "Payerne Radar", position MM2.

### 1.1.3 Air traffic control

Control and surveillance of civil and military traffic departing from and arriving at Payerne aerodrome are provided by controllers delegated by Payerne to the Geneva Control Centre. Among other things, they have the task of separating their traffic from that operating in the G5W airspace controlled by sector INI East, in accordance with ICAO standards and recommendations.

*G5W: term designating all the sections of ATS, DAR, SID and STAR routes between SPR VOR/across SPR VOR and across BER NDB (except Geneva TMA), limited in altitude by the following levels:*

- MOLUS – KORED: FL095 – FL195

- ...

Ref.: Letter of agreement between Terminal Centre Geneva (TCG) and Payerne ATC

### 1.1.4 History of the incident

On the morning of 31 August 2010, a Hawker 4000 aircraft, registration M-KENF, was making a private IFR ferry flight from Geneva to Zurich. It was maintaining FL 160, following ATS route N871 within G5W airspace and was under the control of combined sector INI South/East on the frequency 128.900 MHz.

At 09:19:38 UTC, the pilot of the Mirage III DS aircraft, registration HB-RDF, contacted "Payerne Radar" using the call sign EMIR12 and requested a climb to FL 200 with a view to making a NOLA (emergency landing exercise) approach on Payerne aerodrome. It was flying under visual flight rules (VFR) and was located north of the Col des Mosses at flight level FL 125. The "Payerne Radar" controller assigned it transponder code 1511 and after the pilot's read back reported radar contact. He then telephoned sector INI South/East to report the Mirage and coordinate its entry into G5W airspace: EMIR12 was limited initially to maximum flight level FL 150 because of flight M-KENF, which was crossing 1000 feet higher.

At 09:21:49 UTC, the controller MM2 cleared EMIR12 to climb to flight level FL 150. The pilot of the Mirage read this back and then in a second radiotelephony exchange answered that he accepted a short wait.

At 09:22:21 UTC, he reported that he was at flight level FL 150; the "Payerne Radar" controller asked him to maintain this level and then telephoned Payerne Tower to coordinate the arrival of a military formation of three FA/18 aircraft. The recording of the radar plots shows that the routes of flights EMIR12 and M-KENF intersected at right angles and that at that moment the two aircraft were converging and had an altitude difference of 1000 feet and a lateral distance of 4.7 NM. The flight visibility was more than 10 km and the sky was clear.

At 09:22:25 UTC, the STCA short term conflict alert was activated in sector INI South/East; EMIR12 was passing FL 151 in a climb flying from right to left, 4 NM ahead of and slightly to the right of M-KENF. The INI South/East radar controller then issued essential traffic information to the latter, who replied that he had visual contact. EMIR12 continued its climb to flight level FL 158, which it reached when it crossed the route of M-KENF at 09:22:37 UTC. At this point, the two aircraft reached the closest point of approach, with an altitude difference of 200 feet and a lateral distance of 2.6 NM. The Mirage then descended back to its cleared flight level, reaching it at 09:23:01 UTC.



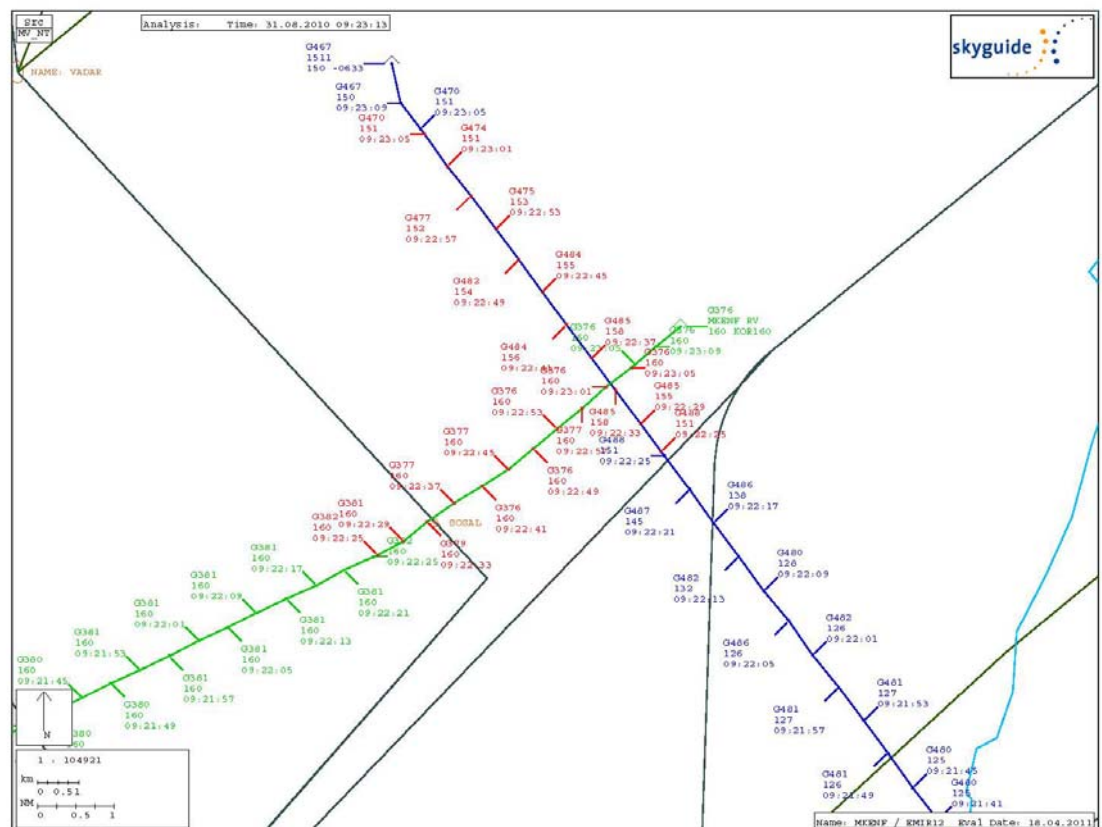
A few seconds later, the INI South/East radar coordinator telephoned "Payerne Radar" to inquire about this level violation. The controller MM2 explained that, given the confirmation by the pilot of the Mirage that he was maintaining flight level 150, he was busy with another coordination and did not notice the violation. He then contacted the latter to confirm the difference in flight level and then informed him of the conflict with M-KENF.

In his statement, the pilot of the Mirage stated he had been momentarily distracted and confirmed he had exceeded the cleared flight level of FL 150. He was not aware of the conflict.

### 1.1.5 Location of the incident

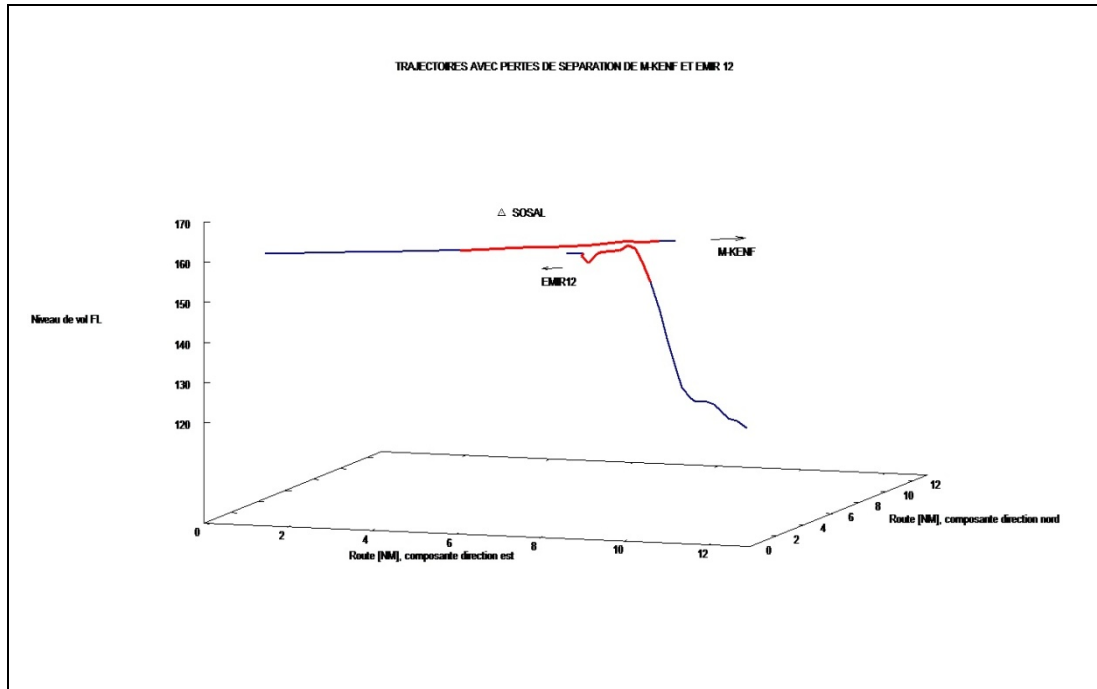
Near waypoint SOSAL (46 33 29 N, 006 53 04 E)

### 1.1.6 Horizontal view at 09:23:13 UTC (radar tracks)

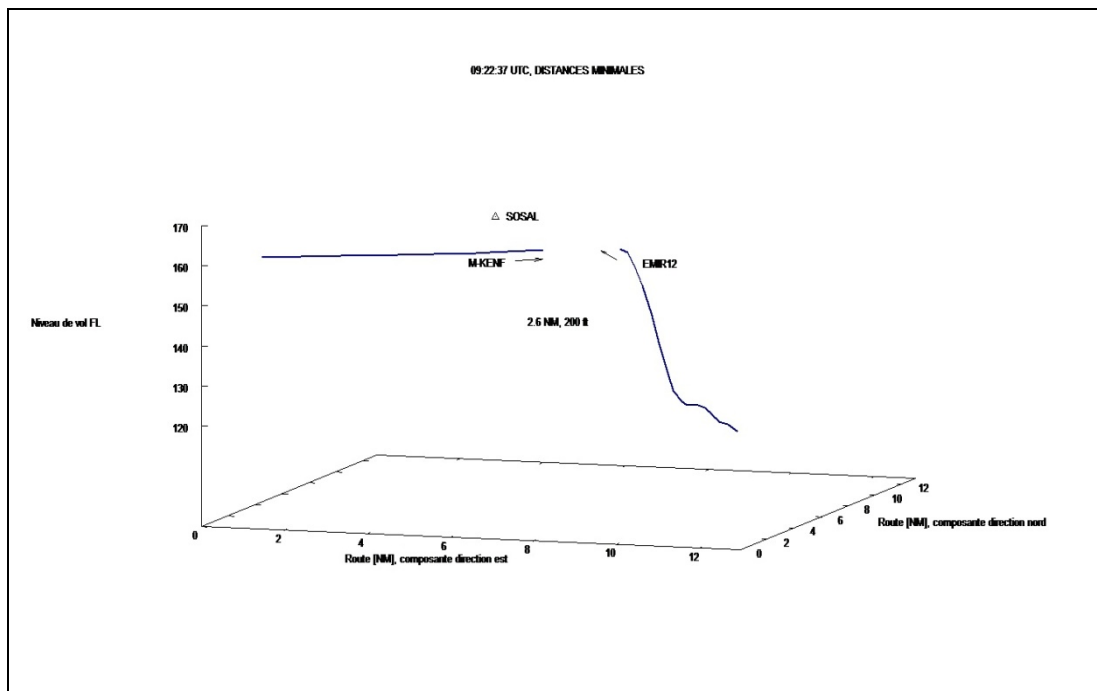


### 1.1.7 Trajectories, minimum separation, flight profile and rate of climb of EMIR 12

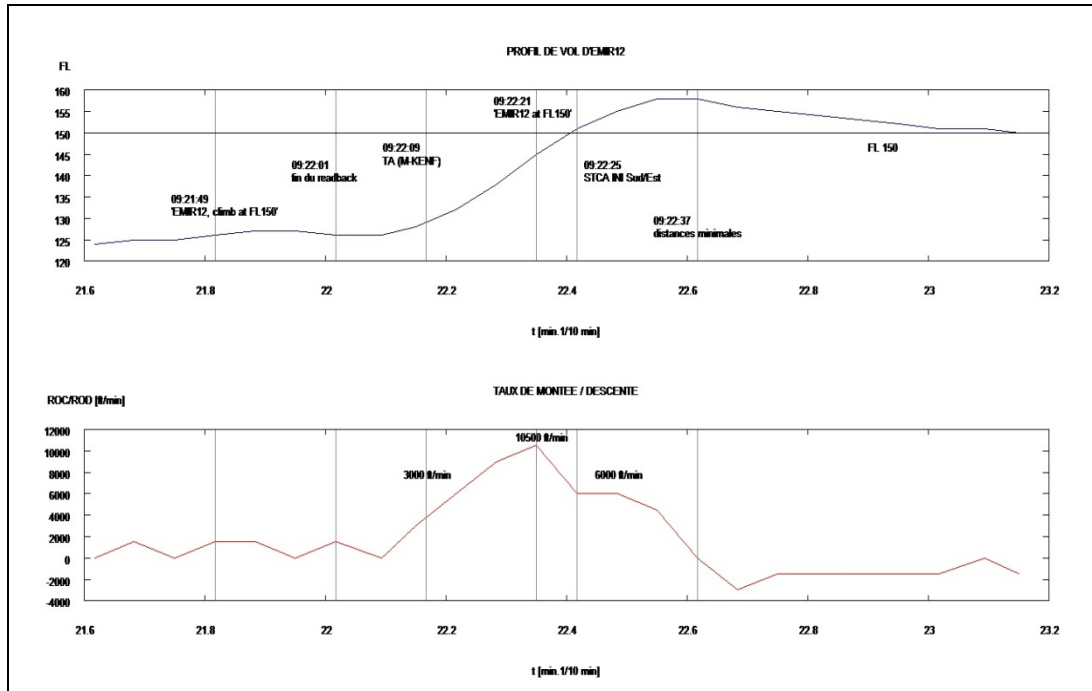
The graphs of the trajectories, separations and vertical speeds of EMIR 12 were produced on the basis of the recordings of the radar plots, the refresh rate of which is 4 seconds; they are therefore representative of the refresh frequency of the radar image. On the latter, flight levels are shown to the nearest 100 feet; it is realistic to assume that for the graphs below the accuracy in terms of the difference in levels does not exceed 50 feet. A calculation of its propagation on the rates of climb/descent gives an accuracy of 750 feet/min.



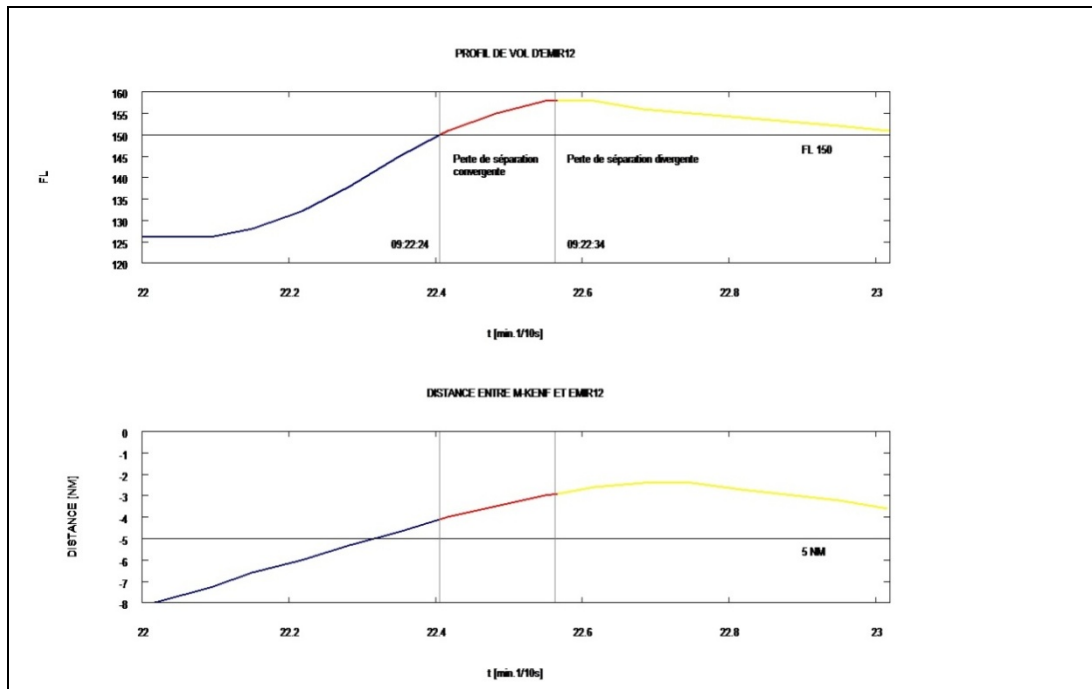
Trajectories with losses of separation between M-KENF and EMIR 12



Minimum distances between M-KENF and EMIR 12



Flight profile and rate of climb/descent of EMIR 12



Losses of separation between M-KENF and EMIR 12

**1.2 Personnel information**

## 1.2.1 Flight crew of M-KENF

## 1.2.1.1 Commander

## 1.2.1.1.1 Training

Person	Swiss citizen born 1971
Licence	Air transport pilot (ATP), issued by the Federal Aviation Administration of the United States of America on 22 January 2010
Ratings class/type	Hawker Beechcraft 4000, pilot in command (PIC), valid till 3 February 2012 English Proficient
Medical certificate	Valid from 22 December 2009 to 13 December 2010
Last medical	22 December 2009

## 1.2.1.1.2 Flying experience

Total hours	4889 hours
of which on the type involved	not communicated
in the last 90 days	59:05 hours
of which on the type involved	59:05 hours
During the last 24 hours	3:45 hours
of which on the type involved	3:45 hours

## 1.2.1.2 Copilot

## 1.2.1.2.1 Training

Person	Austrian citizen, born 1976
Licence	Air transport pilot (ATP), issued by the Federal Aviation Administration of the United States of America on 22 January 2010
Ratings class/type	Hawker Beechcraft 4000, pilot in command (PIC), valid till 3 February 2011 English Proficient
Medical certificate	Valid from 20 January 2010 to 11 January 2011
Last medical	20 January 2010

## 1.2.1.2.2 Flying experience

Total hours	3018 hours
of which on the type involved	not communicated
in the last 90 days	60 hours
of which on the type involved	60 hours
During the last 24 hours	3:45 hours
of which on the type involved	3:45 hours

## 1.2.2 Pilot of aircraft EMIR 12

## 1.2.2.1 Pilot

## 1.2.2.2 Training

Person	Swiss citizen, born 1956
Licence	CPL(A) (commercial pilot licence aeroplane) according to joint aviation requirement (JAR), first issued by the Federal Office of Civil Aviation (FOCA) on 22 October 1980 and valid till 15 September 2015.
Ratings class/type	Mirage III restricted to HB registered aircraft English Level 4, valid till 13 September 2014. No instrument flight rating (IR)
Medical certificate	Class 1 / 2 Valid from 25 October 2010 till 29 October 2011
Last medical	26 April 2010

## 1.2.2.3 Aircraft flying experience

Total hours	4658 hours
of which on the type involved	950 hours
in the last 90 days	8:34 hours
of which on the type involved	1:28 hours
During the last 24 hrs	0:53 hours
of which on the type involved	0:53 hours

## 1.2.3 Air traffic controllers

## 1.2.3.1 Radar controller sector INI South/East

Person	Swiss citizen, born 1974
Start of duty on the day of the incident	06:40 UTC
Licence	Air Traffic Controller Licence, based on European Community Directive 2006/23, first issued by the Federal Office of Civil Aviation (FOCA) on 28 September 2000 and valid till 13 November 2010.
Rating	Ratings: Area Control Surveillance ACS. Rating / Licence Endorsement Endorsements: Terminal Control TCL, Radar RAD,; On-the-Job Training Instructor OJTI  Unit endorsement Control Area CTA; Geneva Area LSAG
Language endorsement	English Level 5 Extended

## 1.2.3.2 Radar coordinator sector INI South/East

Person	Swiss citizen, born 1975
Start of duty on the day of the incident	08:00 UTC
Licence	Air Traffic Controller Licence, based on European Community Directive 2006/23, first issued by the Federal Office of Civil Aviation (FOCA) on 18 December 1998 and valid till 1 February 2011.
Rating	Ratings: Area Control Surveillance ACS. Rating / License Endorsement Endorsements: Terminal Control TCL, Radar RAD, On-the-Job Training Instructor OJTI  Unit endorsement Control Area CTA; Geneva Area LSAG
Language endorsement	English Level 5 Extended

## 1.2.3.3 Controller position MM2

Person Swiss citizen, born in 1971

Start of duty on the day of the incident 06:15 UTC

Licence Air Traffic Controller Licence, based on European Community Directive 2006/23, first issued by the Federal Office of Civil Aviation (FOCA) on 11 April 1997 and valid till 4 July 2011.

Rating Ratings: Aerodrome Control Instrument ADI, Approach Control Surveillance ACS. Rating / License Endorsement: Precision Approach Radar PRA, Radar RAD, surveillance Radar Approach SRA, Tower Control TWR

## Unit endorsement

<i>Location</i>	<i>Sector (-group)</i>	<i>Rating</i>	<i>Rating Endorsement</i>	<i>Valid until</i>
<i>LSAS</i>	<i>PRA</i>	<i>APS</i>	<i>PRA, RAD</i>	<i>04.07.2011</i>
<i>LSAG</i>	<i>DELTA</i>	<i>APS</i>	<i>RAD</i>	<i>04.07.2011</i>
<i>LSMP</i>	<i>MEC</i>	<i>APS</i>	<i>SRA, RAD</i>	<i>04.07.2011</i>
<i>LSMP</i>	<i>SRA</i>	<i>APS</i>	<i>SRA, RAD</i>	<i>04.07.2011</i>
<i>LSMP</i>	<i>TWR</i>	<i>ADI</i>	<i>RAD, TWR</i>	<i>04.07.2011</i>

Language endorsement *English Level 5*

## 1.3 Aircraft information

## 1.3.1 M-KENF

Aircraft type Hawker 4000

Characteristics Twin-jet executive

Constructor Hawker Beechcraft Corporation, Wichita, Kansas, USA

Year of construction 2009

Serial number RC-27

Owner Avalanche Aviation Ltd. Hamilton, Bermuda

Operator Global Jet, L-1030 Luxembourg

Equipment TCAS II version 7

1.3.2	HB-RDF	
	Aircraft type	Mirage III DS
	Characteristics	Single engine, fighter
	Constructor	Avions Marcel Dassault-Breguet Aviation, France
	Year of construction	1982
	Serial number	MD 470
	Owner	Fondation du Musée Militaire de l'Aviation Militaire de Payerne, Switzerland
	Operator	Espace Passion, Air base, CH-1530 Payerne, Switzerland
	Equipment	VFR

## 1.4 Meteorological information

### 1.4.1 General

The information contained in sections 1.4.2 to 1.4.15 was provided by MeteoSwiss (original text in German).

### 1.4.2 General situation

The weather in Switzerland was influenced by a high pressure area centred on the south of England. Winds from the north-east sector were trapping moist air on the northern slopes of the Alps. Moderate winds from the north prevailed in the region of the incident.

### 1.4.3 GAMET

Gamet valid 06 - 12 UTC for the Western Switzerland region

HAZARDOUS WEATHER NIL

Wind/temperature at 10,000 ft AMSL 020/25 kt MS04

Wind/temperature at 5,000 ft AMSL 040/20 kt PS03

0°: FL070

MNM QNH: 1020 hPa

### 1.4.4 AIRMET

At the time of the incident, the following AIRMET was active:

LSAS AIRMET 4 VALID 310900 / 311300 LSZH-

LSAS SWITZERLAND FIR MOD TURB FCST APLS AND S OF ALPS  
SFC/FL140 STNR WKN=

### 1.4.5 SIGMET

No SIGMET was issued on the day of the incident.



## 1.4.6 TAF

The following TAF were active for the airports of Payerne and Geneva:

LSMP 310525Z 3106/3115 VRB03KT 9999 FEW040 TEMPO 3106/3108 4500  
BR BECMG 3107/3109 05010KT=

LSGG 310525Z 3106/3112Z VRB03KT 9999 FEW030 TX18/3115Z TN09/3106Z  
TN07/0104Z BECMG 3106/3108 05010KT TEMPO 3110/3122 05015G25KT  
BECMG 3117/3119 CAVOK=

## 1.4.7 SWC, wind charts

SWC, wind charts valid 12 UTC

The significant weather chart (SWC) (FL 100 - FL 450) issued by the WAFC London does not show any significant feature for the region where the incident occurred.

It shows winds from the north-north-east of 30 kt and a temperature of -9 °C at flight level FL 140. At flight level FL 180, the wind is northerly, at a speed of 45 kt and the temperature is -16 °C.

## 1.4.8 Aviation weather forecast for Switzerland, valid from 06 to 12 UTC

The following hazards were reported:

Moderate wind turbulence from the north over the Alps and the Ticino. Central and eastern Alpine passes in cloud. Moderate icing between 7500 and 12,000 ft AMSL.

## 1.4.9 METAR

METAR for Payerne and Geneva aerodromes for the period of the incident:

LSMP 310850Z 07009KT 040V110 9999 SCT045 14/10 Q1022 RMK BLU=  
LSMP 310920Z NIL  
LSMP 310950Z AUTO 07010KT 9999 FEW030 16/089 Q1022 RMK BLU=  
LSGG 310850Z 03017KT 360V070 9999 FEW030 16/08 Q1021 NOSIG  
LSGG 310920Z 03015KT 340V060 9999 FEW030 16/08 Q1021 NOSIG  
LSGG 310950Z 02016KT 330V060 9999 FEW035 16/08 Q1021 NOSIG

In clear text this means:

On 31 August 2010, just before the transmission of the meteorological aerodrome observation of 08:50 UTC, the following weather conditions were observed on Payerne aerodrome LSMP:

Wind	070° at 9 kt, varying between 040° and 110°
Meteorological visibility	10 km
Cloud	Scattered at 4500 ft AAL
Temperature	14 °C

Dew point	10 °C
Atmospheric pressure	1022 hPa, pressure reduced to sea level, calculated using the values of the ICAO standard atmosphere
RMK BLU	Military colour code: Blue, i.e. no cloud ceiling (clear skies, few or scattered clouds) and visibility of 8 km or more

## 1.4.10 Synoptic messages (Synop)

Ocular synoptic observations at Aigle

	<b>09 UTC</b>
Altitude	381 m AMSL (1250 ft AMSL)
Wind (kt)	020/05
Cloud	4/8 6000 ft AGL (7250 ft AMSL)
Weather	-
Visibility	60 km
Temp./ dewpoint	16 / 10

## 1.4.11 Weather balloon

Values indicated at the altitude of the incident (FL 160, approx. 4900 m AMSL).

Probe	Time	Wind speed and direction	Temp. °C	Dewpoint °C
Payerne	12Z	360 / 40	-12	-24

## 1.4.12 Radar image

In the region of the incident, no precipitation echoes.

## 1.4.13 Satellite image

Virtually no cloud is visible on the satellite image.

## 1.4.14 Photos

On the photo of Mt Pèlerin, scattered cloud can be observed at moderate altitude.

## 1.4.15 Conclusions

Based on this information, the following weather conditions prevailed at the time and place of incident:

Cloud:	scattered at approx. 7500 ft AMSL	
Weather:	clear sky-	
Visibility:	greater than 50 km	
Wind:	north wind, approx. 40 kt	
Temp./dew point:	-12°C / -24°	
Position of the sun	Azimuth: 133°	Elevation: 43°
Natural lighting conditions	Daylight	
Hazards	No significant hazards	

## 1.5 Safety nets

### 1.5.1 Air traffic control

#### 1.5.1.1 The STCA system

Integrated into the Geneva Control Centre's radar processing system, the STCA is a safety net which, in the event of hazardous convergence of aircraft in the vertical and horizontal planes, alerts the controller by means of an audible and visual signal. If the flight geometry is such that loss of separation is predictable, it is activated with an advance warning time (predicting alarm) to allow for the reaction of the controller/pilot/aircraft loop: the controller evaluates the conflict situation, determines the appropriate action and if necessary gives appropriate instructions to the pilots. In the case of a more delayed conflicting convergence, the alert is issued as soon as the critical separation thresholds are violated (proximity alarm); these limits are defined as a function of several parameters and classified into "groups". The geometry of the conflict between M-KENF and EMIR12 met the group 4 criteria, i.e. an altitude difference of 900 feet and a lateral distance of 4.9 NM.

The STCA can only report a conflict when at least one of the aircraft involved is "assigned" and therefore necessarily correlated, in the sector controlling it and the other has its transponder in operating mode. At the time of the conflict, flight M-KENF was assigned to sector INI South/East and EMIR 12 was not assigned to any sector, as it was not correlated, but did have its transponder activated. The conflict between flight M-KENF and EMIR 12 could therefore generate an STCA alert only in sector INI South/East.

#### 1.5.2 Onboard equipment

When two aircraft are equipped with an airborne ACAS system, they exchange complementary resolution advisories in a way which ensures that the resolution advisories issued are compatible; the latter are therefore deemed to be "coordinated".

### 1.5.2.1 Hawker 4000

The Hawker 4000 was equipped with an onboard collision avoidance system of the type TCAS II <sup>1</sup> – Traffic Alert and Collision Avoidance System. This system can generate two types of alerts:

- Traffic Advisories (TA) as reported by the pilot for this incident - which report that a particular intruder aircraft constitutes a possible threat. This indication is intended to prepare the crew for a possible resolution advisory; pilots must not manoeuvre solely on the basis of a traffic advisory.

- Resolution Advisories (RA), the purpose of which is to advise the crew:

a) to execute a manoeuvre to ensure the necessary separation with all threats, or

b) to comply with a restriction on manoeuvres to maintain the existing separation.

The surveillance performance of TCAS is limited to rates of change of altitude for aircraft at or below 10,000 feet/min; above this value, the declaration of a threat (RA) is cancelled.

### 1.5.2.2 Mirage III DS

At the time of the incident, the coordination process was not able to take place because the Mirage does not possess a TCAS-type onboard collision avoidance system.

## 1.6 Aids to navigation

### 1.6.1 Information on aids to navigation and landing

Not applicable.

### 1.6.2 Information on the equipment onboard the Mirage III DS HB-RDS

The Mirage III DS HB-RDS has basic instrumentation for VFR flight, with the altitude indications given in feet and those for speed in km/h. It is equipped with a Mode S transponder operating among other things in modes A and C and three transmitter/receivers (two VHF and one UHF) for radiotelephony communication. The front seat is equipped with a GPS receiver with "Moving terrain" visualisation. It is not equipped with an onboard collision avoidance system.

## 1.7 Procedures

### 1.7.1 Rates of climb/descent for IFR traffic

(.....)

*Depending on phase of flight, the procedures specified below are applicable to all aircraft whose performance data allow:*

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<sup>1</sup> In the rest of the report the term TCAS refers to TCAS II version 7

- *Level changes en route:*  
*during descent, rate of between 1000-2500 ft/min is expected and should be complied with (except within the last 1000 ft to cleared flight level, rate should not exceed 1000 ft/min) and similarly, aircraft climbing to the cleared flight level, the rate of climb within the last 1000 ft should not exceed 1000 ft/min either;*
- (.....)
- *any deviation from the above mentioned rates, if deemed necessary by the pilot, shall be communicated to ATC immediately.*

Ref.: AIP SWITZERLAND ENR 1.3 - 2, § 8

#### 1.7.2 Rates of climb/descent for VFR traffic

Not specified.

#### 1.7.3 NOLA procedures (NotLandeübung: emergency landing exercise)

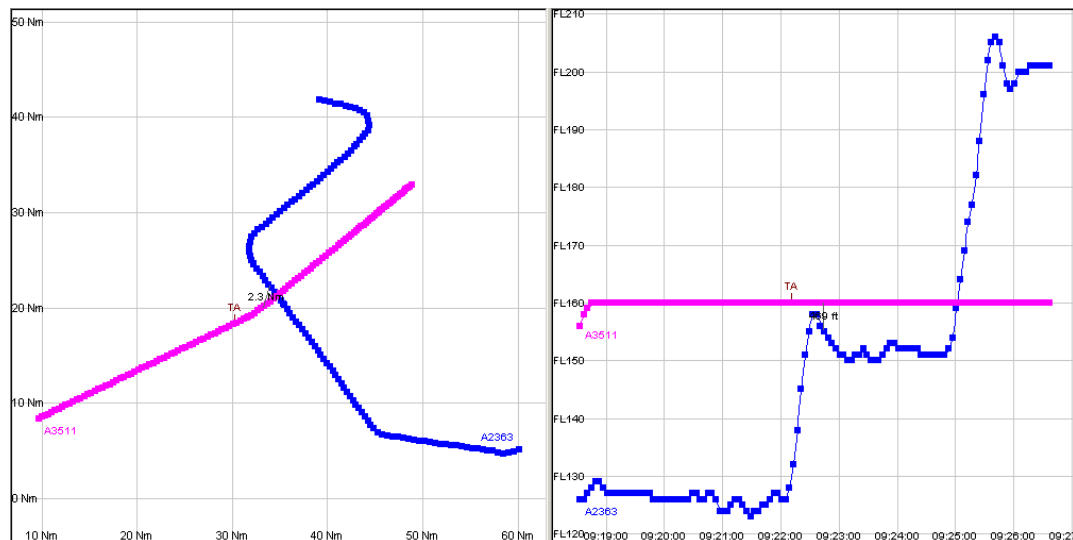
In case of engine failure of the Mirage III in the immediate surroundings of a runway with a length of at least 2000 m and at a flight altitude of more than 20 000 ft, it is possible to land applying the "NOLA" procedure; short for Notlandeübung in German and meaning emergency landing. It consists of executing a specific visual circuit.

The supervision authority requires the training of this procedure for revalidation of the type rating on a yearly basis.

### 1.8 Useful or effective investigation techniques

#### 1.8.1 TCAS simulation

On the basis of the recording of the radar plots, EUROCONTROL's InCAS software tool was able to reconstruct the conflicting trajectories of the aircraft and recreate the alarms which were probably issued by the onboard collision avoidance system of the Hawker 4000 M-KENF. The traffic advisories and resolution advisories are reliable, even though the sequence of the latter may be subject to a delay of a few seconds compared to reality: this is because the operations of the algorithms of onboard collision avoidance systems follow a cycle which repeats at a nominal rate of at least once per second whereas the radar data has a longer refresh period. The consistency of the results of this simulation must be checked against other sources of information such as the accounts of the flight crews, the recordings of the TCAS parameters, the Mode S data, etc.



Horizontal situation

Profiles

The simulation reports a traffic advisory (TA) issued at about 09:22:10 UTC onboard M-KENF.

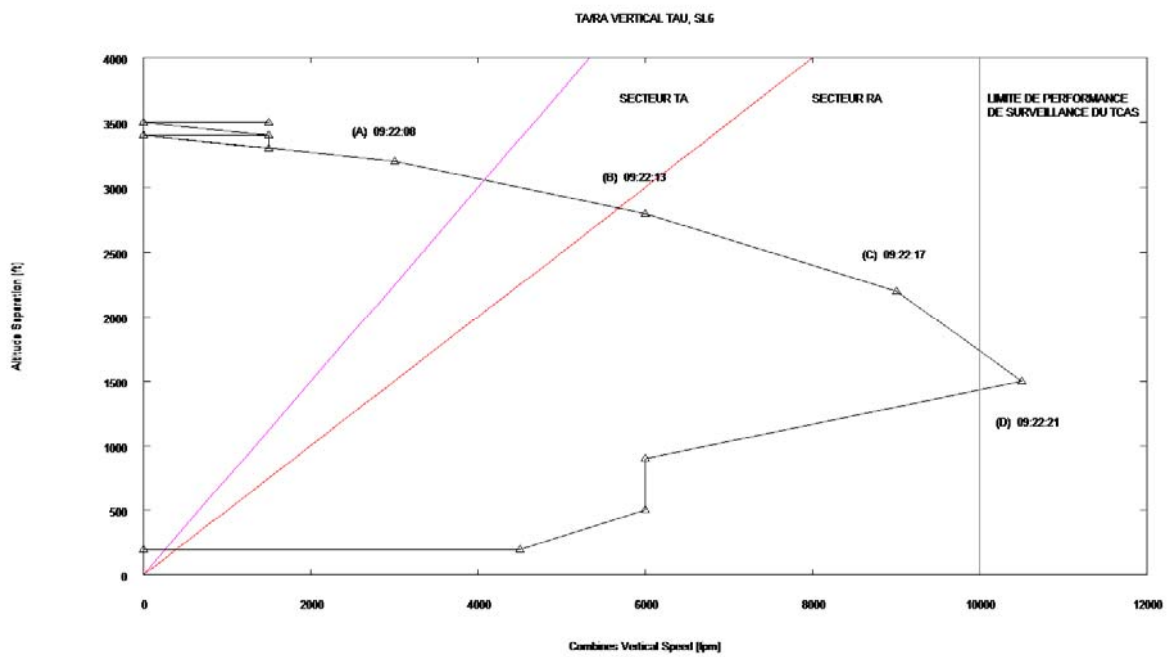
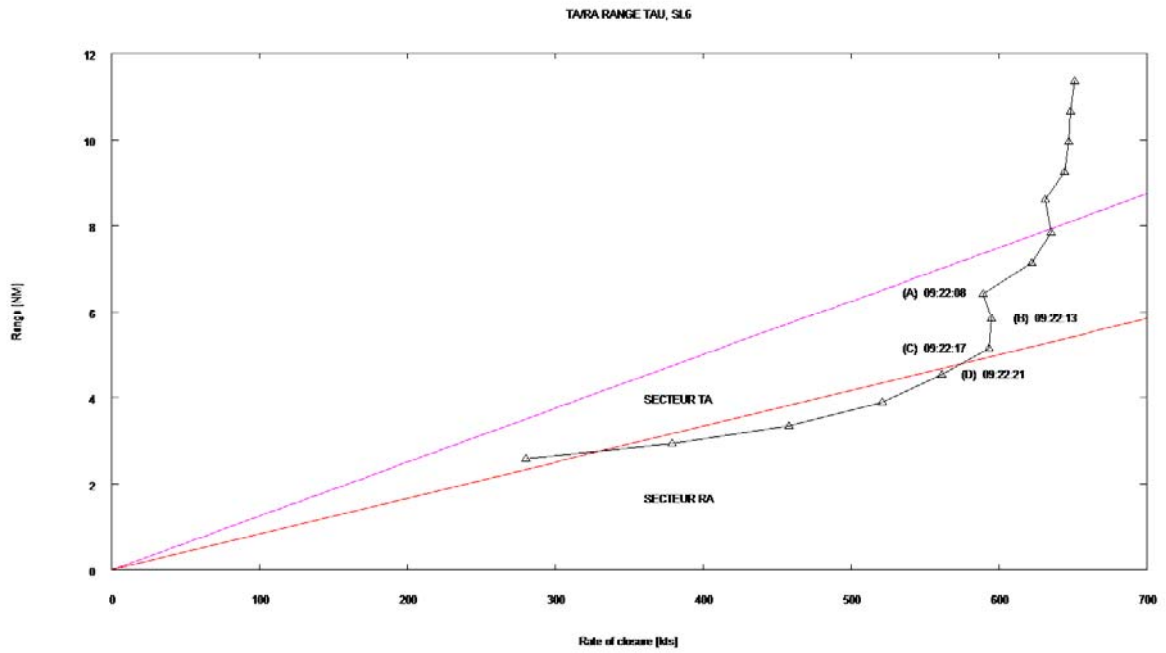
The profile view of the trajectories clearly shows the Mirage overshooting FL 150. At 09:25:40 UTC the same fact is observed for the acquisition of FL 200, giving rise at 09:25:43 UTC to a remark by the "Payerne Radar" controller to the Mirage pilot.

#### 1.8.2 "TA/RA range tau" and "TA/RA vertical tau" diagrams

The TCAS system is based on the concept of the time "tau" which it will take an aircraft equipped with the system to cover the distance to the closest point of approach (CPA) with the conflicting aircraft. The time taken to cross the oblique distance which separates them is termed the "range tau" and the time to arrive at the same altitude the "vertical tau". When the two times fall simultaneously below threshold values which depend on the altitude band in which the conflicting aircraft are flying, traffic/resolution advisories are issued; this parameter which defines the sensitivity of the TCAS system as a function of altitude is termed the "sensitivity level" (SL).

The alarm sectors can be visualised on diagrams called "TA/RA range tau" and "TA/RA vertical tau", which make it possible to represent the sequence of appearance of the TA and RA advisories; in reality the boundaries of these areas are changed slightly owing to the need for alerts which have to be taken into account in the case of threats with a low rate of convergence.

On the basis of the recordings of the radar plots, these "TA/RA" diagrams show the parameters of the relative positions of the conflicting aircraft during the critical phase of the incident, at the 4 second radar refresh rate.



1.8.3 Mode S downlinks

A reading of the downlinks from the M-KENF transponder did not reveal the issuing of a resolution advisory RA at the time of the incident.

## **1.9 Organisational and management information**

### **1.9.1 Espace Passion**

Espace Passion is a non-profit association involved in the collection and preservation of the Swiss military aviation heritage. Among other things, it maintains, restores and flies old aircraft such as the Mirage III DS HB-RDF, which has been in operation since September 2008 for passenger flights. The aircraft completes 20 to 25 flight hours per year.

## **1.10 Additional information**

### **1.10.1 Statements/incident reports**

#### **1.10.1.1 Mirage pilot**

In his statement, the pilot of EMIR 12 reported that the incident flight constituted his proficiency check on the Mirage. The rear seat in the aircraft was occupied by a passenger and an instructor-examiner on the ground was supervising the flight. He declared that the meteorological conditions were perfect.

He stated that once cleared to climb to flight level FL 150, he had applied the military flight technique which involves adopting a high rate of climb to reach it as quickly as possible. He added that he had been momentarily distracted and confirmed that he had exceeded the cleared flight level of FL 150. He was not aware of the conflict.

#### **1.10.1.2 Flight crew of M-KENF**

A TCAS incident report was completed by the flight crew of M-KENF. It states that only a traffic advisory (TA) was issued on the occasion of the conflict and that ATC subsequently issued traffic information about an aircraft which had crossed their path from right to left, slightly lower. It was stated that the pilots acquired visual contact with the fighter before this information.



## 2 Analysis

The conflict took place in a particular context: it occurred in a portion of airspace C, the conflicting aircraft were being handled by two different control sectors, with great differences in terms of performance, and did not operate under identical flight rules. In this environment, all separation procedures between flights admitted and performance limitations for IFR flights are clearly defined ( § 1.1.2 and 1.7.1). Nothing in regard to climb and descent rates of VFR flights is specified and the risk of a level bust with excessive vertical speeds is greater.

### 2.1 Loss of separation

The graphs drawn on the basis of the radar recordings (§ 1.1.6) show that the separation between M-KENF and EMIR 12 was lost during 41 seconds (less than 5 NM lateral distance and 1000 feet altitude difference) for 41 seconds between 09:22:24 UTC and 09:23:05 UTC. The trajectories were converging for the first 10 seconds of the conflict and the closest point of approach occurred at 09:22:37 UTC where the aircraft were separated by a lateral distance of 2.6 NM and an altitude difference of 200 feet. At this point the Mirage was at the apogee of its climb, flying away from the Hawker 4000.

### 2.2 Safety nets

#### 2.2.1 STCA system

Just before the Mirage's climb to flight level FL 150, the two aircraft were separated by a lateral distance of 7.3 NM and an altitude difference of 2400 feet, values which were not sufficient to meet the criteria for a "predicting" alert if the flight geometry were to be conflicting.

The graph of the flight profile and the rate of climb/descent of EMIR12 reveal that the STCA alarm was activated in sector INI South/East when EMIR12 was passing flight level FL 151 and that it was a "proximity" type (group 4, triggered by differences in altitude of 900 feet and a lateral distance of 4.9 NM).

#### 2.2.2 Onboard collision avoidance system

During the conflict, the Mirage was flying at rates of climb which approached the monitoring performance limit of the TCAS (10,000 ft/min); it is therefore useful to determine whether at this moment the conditions for issuing an RA resolution advisory were met. To this end, the "TA/RA" diagrams constitute a theoretical working tool enabling visualisation of the area of operation and the sequence of alarms issued by the TCAS system.

The time interval between points A at 09:22:09 UTC and 09:22:13 UTC, as expected, corresponds to the moment when the TA traffic advisory reported by the flight crew of M-KENF was issued. From 09:22:17 UTC (point C) to 09:22:21 UTC (point D), the rate of climb of EMIR 12 increases and the parameters of the relative positions of the conflicting aircraft are simultaneously in the RA alarm sectors of the "TA/RA range tau" and "TA/RA vertical tau" diagrams. The conditions for the issue of an RA resolution advisory are theoretically met but since then the vertical speed of the Mirage is close to the TCAS monitoring performance limit (10,000 ft/min), it is likely that this resolution advisory (RA) was cancelled.

Subsequently, the geometry of the conflict is such that the rate of convergence and above all the rates of climb diminish very rapidly, which is why resolution

advisories were not then issued even though the aircraft were still within the RA alarm sector. This corroborates the statements of the flight crew of M-KENF, the Mode S transmission and the results of the TCAS simulation.

## 2.3 Flight management aspects

### 2.3.1 M-KENF

On board the Hawker 4000, the incident produced a traffic advisory (TA) and essential traffic information; its trajectory did not have to be modified.

### 2.3.2 Mirage EMIR 12

The graphs of the flight profile and the rate of climb/descent of EMIR 12 show that during the climb to flight level FL 150 the vertical speed of the Mirage increases continuously up to 10,500 feet/min. When its pilot reported to the air traffic controller that he was at flight level FL 150, the aircraft was actually 500 feet lower, at the maximum rate of climb of 10,500 ft/min. In the 4 seconds which followed, the rate decreased by half and the aircraft was 100 feet above the cleared level, with a vertical speed of 6000 feet per minute. It was maintained at this value for a few seconds and then decreased in a discontinuous fashion until it reversed to a rate of descent after the peak of the trajectory at flight level FL 158.

The shape of these curves is representative of a poorly anticipated level acquisition, because of the very high rate of climb: at 10,500 feet/min, the remaining 500 feet to reach flight level FL 150 are travelled within 3 seconds, and stabilising the flight under these conditions requires that the vertical speed drop from 10,500 to 0 ft/min over the same period of time. It indicates that the pilot probably first reacted quickly with the instinctive aim of not exceeding flight level FL 150. Once this limit was reached, the correction is frozen for a few seconds at this transient value of 6000 feet/min - time to allow him to adapt the corrections to be made in order to reach the cleared level less precipitately, probably in consideration of the passenger's comfort.

For the TCAS simulation (§ 1.8.1), the trajectories of the conflicting aircraft were reconstructed until about 4 minutes after the incident. It is noteworthy that when EMIR 12 is cleared to leave flight level FL 150 (09:24:44 UTC), the pilot adopts exactly the same high-rate climb technique as that which was the cause of the incident. Once again the acquisition of flight level FL 200 was carried out with a significant overshoot (600 to 700 feet).

Flight EMIR 12 constituted the pilot's proficiency check; if the rear seat of the aircraft had been occupied by the instructor-examiner in charge of this examination, he would have had the possibility of being able to intervene to prevent the level overshoot which caused the incident.

## 2.4 Air traffic control aspects

The entry of the Mirage EMIR 12 into G5W airspace was coordinated between the sectors "Payerne Radar" and INI South/East and there was no indication of an impending loss of separation.

In INI sector South/East, it was the "proximity" type STCA alarm which attracted the attention of the controllers to the conflict; by then, separation had already been lost, but the geometry of the conflict now excluded the risk of collision; the transmission of essential traffic information to M-KENF was appropriate.

If the STCA system had been able to be used in the military control sector, the alert would have been issued just at the moment (09:22:25 UTC), when the controller was answering with "*Maintain*" the report by the pilot of EMIR12 stating that he was at flight level FL 150. In these circumstances the warning could have been considered untimely, but it would probably have drawn the controller's attention to the impending conflict.

At the systems level, this incident reveals the limits of the STCA system and is indicative of the problem posed by the management of the same portion of airspace by two different control sectors. Technically, when aircraft are flown at very high performance levels, which are inappropriate for civil airspace, the STCA loses its predictive function and therefore its effectiveness.

### 3 Findings

#### 3.1.1 General framework

- The air traffic controllers were in possession of appropriate licences.
- The pilots of the aircraft involved in the incident were in possession of appropriate licences.
- The incident flight constituted the proficiency check of the pilot of EMIR 12 on the Mirage. The rear seat in the aircraft was occupied by a passenger and an instructor-examiner on the ground was supervising the flight.
- The incident took place in Class C airspace, near waypoint SOSAL, 17 km north of Montreux.
- Flight M-KENF was flying according to instrument flight rules (IFR) and was controlled by sector INI South/East.
- The Mirage III DS was flying according to visual flight rules (VFR) and was being handled the military sector "Payerne Radar".
- Visual meteorological conditions prevailed at the time and place of the incident.

#### 3.1.2 History of the incident

- At 09:21:49 UTC, the controller M2 cleared EMIR 12 to climb to flight level FL 150.
- A traffic advisory TA was issued on board the Hawker 4000 M-KENF.
- At 09:22:21 UTC, the pilot of the Mirage reported that he was at flight level FL 150.
- At 09:22:25 UTC, the STCA short term conflict alert was activated in sector INI South/East.
- At 09:22:37 UTC, the closest point of approach between the two aircraft was reached: an altitude difference of 200 feet and a lateral distance of 2.6 NM.
- At 09:22:38 UTC, the INI South/East radar controller issued essential traffic information to M-KENF, which answered that they had visual contact.
- Separation between M-KENF and EMIR 12 was lost for 41 seconds. The trajectories were converging for the first 10 seconds of the conflict.

### 3.1.3 Post-incident facts

- At 09:25:40 UTC, the Mirage overshot its cleared flight level FL 200.
- In his statement, the pilot of EMIR 12 stated that once cleared to climb to flight level FL 150, he had applied the military flight technique which involves adopting a high rate of climb to reach it as quickly as possible.
- He added that he had been momentarily distracted and confirmed that he had exceeded the cleared flight level of FL 150. He was not aware of the conflict.
- The analysis of the radar tracks revealed that at the moment when the pilot of EMIR 12 informed the air traffic controller that he maintains flight level FL 150, the aircraft was actually 500 ft lower, at the maximum rate of climb of 10 000 ft/min.

### 3.1.4 Technical aspects

- The conflict between flight M-KENF and EMIR 12 was able to generate an STCA alert only in sector INI South/East.
- The Hawker 4000 M-KENF was equipped with a TCAS onboard collision avoidance system.
- The Mirage III DS HB-RDS was equipped with a Mode S transponder.
- The Mirage III DS was not equipped with an onboard collision avoidance system.

## 3.2 Cause

The incident is due to the fact that a pilot of a VFR flight adopted an excessive rate of climb in controlled civil airspace and that the aircraft overshot the assigned flight level, causing a dangerous convergence with an aircraft operating under instrument flight rules.

## 4 Safety recommendations

According to the provisions of Annex 13 of the ICAO, all safety recommendations listed in this report are intended for the supervisory authority of the competent state, which has to decide on the extent to which these recommendations are to be implemented. Nonetheless, any agency, any establishment and any individual is invited to strive to improve aviation safety in the spirit of the safety recommendations pronounced.

Swiss legislation provides for the following regulation regarding implementation in the Ordinance on the Investigation of Aircraft Accidents and Serious Incidents:

“Art. 32 Safety recommendations

- <sup>1</sup> DETEC shall address implementation assignments or recommendations to FOCA, based on the safety recommendations in the reports from SAIB or on the foreign reports.
- <sup>2</sup> FOCA shall inform DETEC regularly about the implementation of the assignments or recommendations.
- <sup>3</sup> DETEC shall inform the SAIB at least twice a year about the progress made by FOCA with implementation.”

### 4.1 Safety deficit

A business jet operated under instrument flight rules at flight level FL 160 along an airway, within class C airspace. A high performance aircraft, in the climb and operating under visual flight rules, was cleared to cross the same airway at flight level FL 150. The two aircraft were controlled by air traffic controllers assigned to two different sectors. The routes of the two aircraft converged at a right angle and the aircraft in the climb had a rate of climb in the order of 10 000 ft/min when passing flight level FL 145. It overshot its cleared flight level by 800 ft and levelled off a few seconds later. The loss of separation was 200 ft vertically and 2.6 NM horizontally.

Procedures limiting rates of climb/descent to values between 1000 and 2500 ft/min for level changes en-route or attaining of a flight level are laid down for flight operating under instrument flight rules (Ref.: AIP SWITZERLAND ENR 1.3 - 2, § 8). There are no procedures laid down for flights operating under visual flight rules in controlled airspace.

### 4.2 Safety recommendation no. 442

The Federal Office of Civil Aviation should require that all aircraft operating within a controlled airspace are bound to the same procedures restricting their rates of climb/descent during en-route level changes and when attaining a flight level.

Payerne, 15 December 2011

Swiss Accident Investigation Board

*This final report was approved by the management of the Swiss Accident Investigation Board SAIB (Art. 3 para. 4g of the Ordinance on the Organisation of the Swiss Accident Investigation Board of 23 March 2011).*

*Berne, 26 January 2012*