

BEA

Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

ANNUAL REPORT 2016

www.bea.aero



Summary

| | |
|---|-----------|
| A MESSAGE FROM THE DIRECTOR | 3 |
| 1 - Overview of Accidents, Investigations Initiated in 2016 by BEA | 5 |
| 1.1 General context | 6 |
| 1.2 Data for accidents and investigations involving the BEA | 6 |
| 2 - Investigations Closed, Reports Published in 2016 | 11 |
| 3 - General Considerations on Air Safety in France in 2016 | 15 |
| 3.1 Commercial air transport | 16 |
| 3.2 General aviation | 16 |
| 4 - Safety Recommendations | 19 |
| 4.1 Overview | 20 |
| 4.2 Safety recommendations issued | 20 |
| 4.3 Responses to Safety Recommendations | 23 |
| 5 - Laboratory Activity (Engineering department) | 25 |
| 5.1 Overview of Engineering Department Activity 2016 | 26 |
| 5.2 Flight recorders and avionics systems branch | 26 |
| 5.3 Structure, equipment and engines branch | 28 |
| 6 - Communication, International Activities, Public Relations and Assistance to Families | 29 |
| 6.1 Communication activities | 30 |
| 6.2 Collaboration with foreign investigation organisations | 31 |
| 6.3 Training actions | 31 |
| 6.4 Participation in the work of international organisations | 31 |
| 6.5 Information to families | 33 |
| 7 - Human Resources, Finance | 35 |
| 7.1 Personnel | 36 |
| 7.2 The budget | 36 |

A MESSAGE FROM THE DIRECTOR



The safety record of Civil Aviation in France for 2016 is positive overall, both for commercial air transport and general aviation: no major commercial air transport accidents occurred on French territory, nor were there any for French operators abroad. The statistics for general aviation show a downward trend in the number of victims of accidents and towards levels never before recorded.

In fact, 2016 was notable for three commercial air transport events that occurred abroad, which a large part of our resources for long periods of time: the accident to a Super Puma helicopter in Norway in April, the accident to an Airbus A320 that disappeared over the Mediterranean Sea in May, and the accident to an ATR in Pakistan in December.

The accident to the Egyptair A320, which was flying the Paris CDG-Cairo route, caused 66 fatalities. Our human and financial resources were immediately mobilised to assist the Egyptian authorities responsible for the safety investigation to localize the wreckage. In the first few days, in the context of collaboration between the BEA, the French Navy and the Alseamar company, the wreckage was located. We then participated in the operations directed by the Egyptian authorities, to recover the recorders. These had been damaged at the time of the impact, and were then repaired and then read out by our specialised laboratory. The investigation is still ongoing and we are still waiting for the elements held by the Egyptian authorities, on the basis of which safety lessons can be drawn from this accident.

The BEA has already noted a strong increase in its international activities over the last few years through its participation, as Accredited Representative, in investigations led by foreign organisations that occurred on their territory, specifically to aircraft designed or manufactured in French. This increase accelerated considerably in 2016: this was, of course, linked to the success of the national aeronautical industry which has led to a great increase in the number of these aircraft in the world fleet (there are now far more than 20 000).

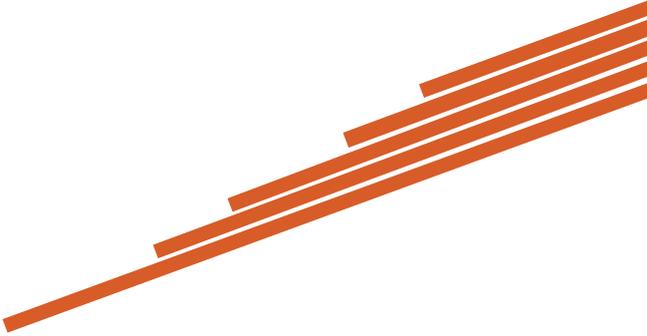
On the other hand, 2016 saw a net decrease in the number of investigations undertaken by the BEA on events that occurred in France. This decrease has to be correlated with the good statistics for general aviation: the number of accidents in general - and of fatal accidents in particular - has fallen. The trend is especially notable in relation to microlight activity. The BEA had modified its procedures two years ago in order to allow an investigation to be launched automatically in any case of a fatal microlight accident. This effort will be continued in future years, with the aim of further improving safety.

Finally, I must mention here the publication of two reports on major investigations in 2016: the report on the accident to the Germanwings A320 D-AIPX, that occurred in the Alps in 2015, and the report on the accident to an Swiftair MD83 that occurred in Mali in 2014 (this report was published by the authorities of the Republic of Mali, with a significant contribution from the BEA). These reports were the result of close collaboration between the BEA and all participants in civil aviation and well illustrate the BEA's motto: « **Safety Together** ».

I hope that 2017 will, by application of this motto, be the best year possible!

Rémi Jouty





**1 - OVERVIEW OF ACCIDENTS, INVESTIGATIONS INITIATED
IN 2016 BY BEA**

1.1 General context

In accordance with EU regulation 996/2010, any civil aviation accident or serious incident is the subject of a safety investigation in the Member State of Occurrence. This requirement applies to all aircraft, except those listed in Annex 2 of Regulation 216/2008 (the aircraft listed in this Annex are mainly non-certificated aircraft: microlights, aeroplanes of historic interest, etc.). European regulation 996/2010 also provides that States may investigate other events, including incidents that do not fit into the category of serious incidents.

Annex 13 to the Convention on International Civil Aviation, known as the Chicago Convention, also specifies that, when a security investigation is conducted by a State (usually the State of Occurrence of the event), the State of the Operator, the State of Registry and the State of Manufacture of the aircraft involved participate in this investigation, by naming an accredited representative (AccRep).

In France, the BEA is the authority responsible for safety investigations. Its procedures, in place since January 1st 2015, provide that in addition to the investigations it has an obligation to conduct in accordance with European regulation, it also investigates the following events:

- reported incidents, which are of particular interest for safety;
- fatal accidents to aircraft listed in EU regulation n° 216/2008.

The modification in procedures on 1st January 2015, aimed at ensuring systematic initiation of an investigation into fatal accidents for Annex 2 aircraft, was introduced in order to re-orient BEA actions towards the most serious events, which are considered to be the most enlightening in terms of safety lessons.

1.2 Data for accidents and investigations involving the BEA

The data presented in this first chapter involve accidents that occurred in France, investigations initiated by the BEA in 2016, investigations initiated by foreign investigation bodies in which the BEA is participating - or participated - by nominating an accredited representative (ACCREP), and the BEA teams sent to accident sites.

1.2.1 Number of accidents

The data in the table below come from two sources:

- investigations conducted by the BEA;
- information provided by Field Investigators on non-fatal Annex 2 aircraft accidents that are not the subject of a BEA investigation.

| Accidents in France in 2016 | | | | |
|---|---------------------|----------------|--------------------|----------------|
| | Number of accidents | | Number of injuries | |
| | Total | Of which fatal | Total | Of which fatal |
| COMMERCIAL AIR TRANSPORT^(*) | | | | |
| Aeroplanes | 3 ^(**) | 0 | 0 | 1 |
| Commercial air transport Total | 3 | 0 | 0 | 1 |
| AERIAL WORK | | | | |
| Aeroplanes | 0 | 0 | 0 | 0 |
| Helicopters | 2 | 0 | 0 | 1 |
| Microlight | 2 | 0 | 0 | 1 |
| Aerial Work Total | 4 | 0 | 0 | 2 |
| GENERAL AVIATION | | | | |
| Aeroplanes | 76 | 11 | 16 | 10 |
| Helicopters | 8 | 1 | 1 | 0 |
| Gliders (including motorised) | 20 | 3 | 3 | 3 |
| Balloons | 1 | 1 | 1 | 0 |
| Microlights (including) | 117 | 14 | 16 | 35 |
| General aviation Total | 222 | 30 | 37 | 48 |
| TOTAL | 229 | 30 | 37 | 51 |

^(*)Previously Public Transport

^(**)It should be noted that the number of accidents reported may differ from the number of accident aircraft because the same accident may involve several aircraft: the number of gliders in general aviation, and public transport aeroplanes involved in accidents in 2016 was thus 21 and 4, respectively.

The three accidents in commercial air transport (CAT) were:

- the longitudinal runway excursion by a twin-engine piston aeroplane at Saint-Barthélemy (977) aerodrome, whose consequences were only material;
- the collision at Paris Charles-de-Gaulle (95) between one towed twin-jet and another at the holding point, whose consequences were also only material;
- an electrocution injury to a ground assistant, while connecting the GPU to the aeroplane after its arrival at Bastia (2B).

The main elements in 2016 general aviation accidentology are presented in chapter 3.

1.2.2 Investigations initiated by the BEA

| Investigations initiated by the BEA in 2016 | | | | | |
|---|--------------------------|------------------|-------------|------------|-----------------|
| Type of event | Commercial air transport | general aviation | Aerial work | Total | (Total in 2015) |
| Accidents | 3 | 93 | 2 | 98 | (147) |
| Serious incidents | 5 | 8 | 2 | 15 | (6) |
| Incidents | 1 | 2 | 0 | 3 | (4) |
| TOTAL | 9 | 103 | 4 | 116 | (157) |
| (Total in 2015) | (7) | (141) | (9) | (157) | |

The number of investigations initiated by the BEA in commercial air transport is of the same order as that of the previous year.

It should be noted that for the first time in 2016, the BEA initiated two investigations on loss of separation with drones. These two events involved de commercial air transport aeroplanes on approach and were classified as serious incidents.

In general aviation, comparison with the previous year is facilitated by procedures on Annex 2 aircraft remaining in force. Thus, as for aerial work, the reduction in the number of investigations initiated in general aviation directly reflects the fall in the number of accidents, especially fatal ones.

The number of investigations initiated by the BEA, as indicated above, is much lower than the number of accidents, since non-fatal Annex 2 leisure aviation accidents in particular were subject to an investigation only in certain specific cases.

1.2.3 Investigations initiated by a foreign investigation body for which the BEA nominated an accredited representative (ACCREP)

| Foreign investigations initiated in 2016 for which the BEA nominated an ACCREP | | | | | | | |
|--|--------------------------|------------------|-------------|----------------|-----------|------------|-----------------|
| Type of event | Commercial Air Transport | General aviation | Aerial work | State aircraft | Unknown | Total | (Total in 2015) |
| Accidents | 32 | 53 | 17 | 9 | 14 | 125 | (124) |
| Serious incidents | 118 | 7 | 4 | 1 | 1 | 131 | (75) |
| Incidents | 17 | 1 | 0 | 0 | 0 | 18 | (22) |
| TOTAL | 167 | 61 | 21 | 10 | 15 | 274 | (221) |
| (2015 total) | (115) | (58) | (29) | (7) | (12) | (221) | |

BEA participation in foreign investigations as accredited representative (ACCREP) which settled at a high level (slightly over 200) during previous years, increased by about 25% in 2016 in comparison with the previous year, so that, for the first time, the number of ACCREP investigations is more than double the number of investigations initiated by the BEA. As already highlighted, this is mainly the result of the success of the national aviation industry and the high level of exports (both for commercial air transport aeroplanes and general aviation, as well as helicopters and engines).

The increase in the number of ACCREP investigations in 2016 mainly involved investigations of events classified as serious incidents in commercial air transport (118 in 2016 compared to 59 in 2015). It should however be noted that this increase may be linked to variations in the classification criteria for serious incidents, and decisions to initiate investigations by the States of Occurrence.

1.2.4 Go-teams

In the case of a particularly serious accident (in France or abroad), the BEA sends a team of investigators to the site without delay. The size and composition of this team (commonly referred to as the go-team) are defined on a case-by-case basis.

In 2016, the BEA sent large teams to the sites of two major events that occurred to commercial flights. The first was the accident to the Airbus Helicopters EC225 registered LN-OJF, which occurred on 29 April at Turoy in Norway. The second was the accident to the Airbus A320 registered SU-GCC, flight MS804, operated by Egyptair, which occurred on 19 May 2016 off the coast of Egypt.

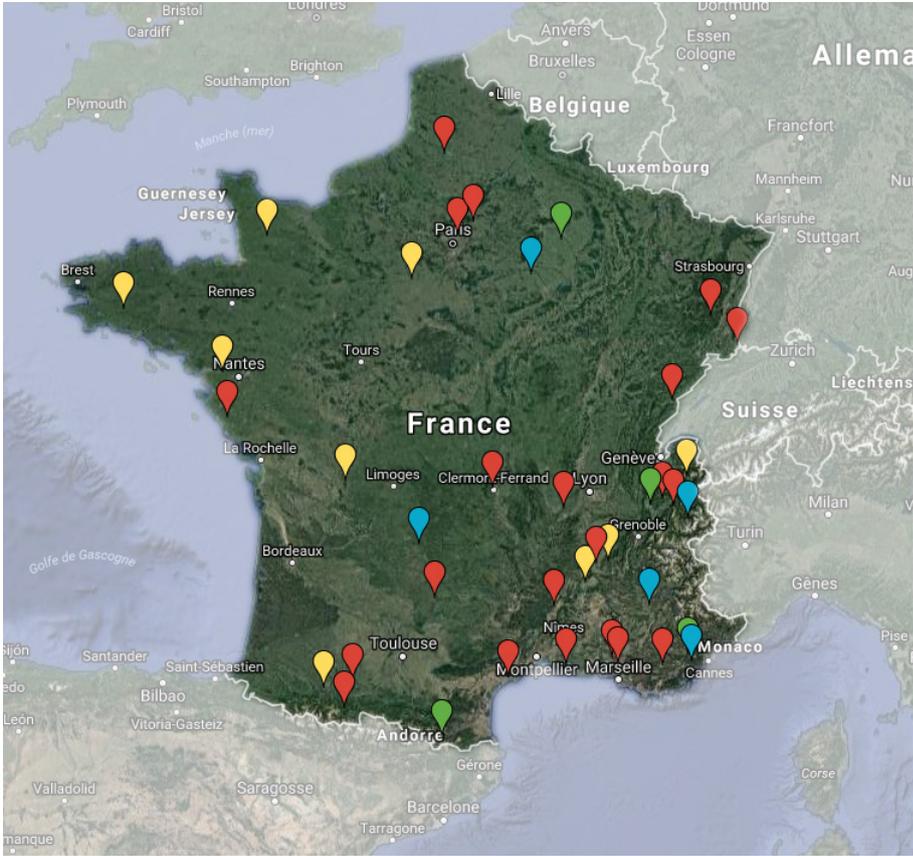
In addition, the BEA provided assistance for the accident to the ATR 42-500 registered AP-BHO, operated by Pakistan International Airlines, which occurred on 7 December at Havelian in Pakistan. The collision with the ground, in descent, led to the destruction of the aeroplane and the death of all of the occupants. In coordination with the Investigator-in-Charge from the PSIB, the BEA's Pakistani counterpart, and with the French Embassy, a visit by the manufacturer ATR's advisers was organized. The BEA considered that the security conditions were not adequate to send a go-team during the on-site phase. With the agreement of the Investigator-in-Charge, the flight recorders were brought to France for their content to be read out and analyzed by the BEA. The BEA and ATR subsequently participated in various meetings organised in Islamabad by the PSIB, with support provided by the French Embassy.

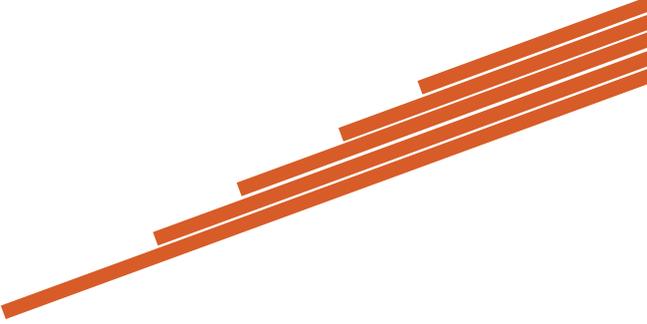
In 2016, 50 go-teams were dispatched, of which seven were sent abroad: Brazil (two go-teams), Taiwan, Norway, Egypt, Malta and Russia. In comparison, in 2015, the BEA had sent out 58 go-teams, of which 17 abroad.

- Brésil
- Mer méditerranéenne
- Norvège
- Russie
- Taïwan
- Brésil



- Avion
- Hélicoptère
- ULM
- Planeur





2 - INVESTIGATIONS CLOSED, REPORTS PUBLISHED IN 2016

Over and above the number of accidents and investigations initiated, the number of investigations closed and reports published are the most relevant indicators of the BEA's activity.

European Regulation 996/2010 specifies that each Safety Investigation must be concluded with a report in a format that is adapted to the type of event. The closing of an investigation is thus marked by BEA with a report that can take two forms:

- ❑ ICAO reports: these reports follow a systematic format, defined by ICAO Annex 13. They are generally reserved for the most important events. In 2015, the BEA published six reports of this type (see box) and contributed greatly to the publication by the Mali Commission of Inquiry of the report on the accident on 24 July 2014 near Gossi (Mali) to the Swiftair MD83 registered EC-LTV (Flight MH370): this report contains ten safety recommendations issued jointly by the Mali Commission of Inquiry and the BEA.
- ❑ Simplified reports: these reports contain only the relevant elements from the plan in Annex 13. They are, specifically, for events such as incidents in Commercial Air Transport or General aviation accidents. In 2016, the BEA published 9 simplified reports relating to Commercial Air Transport, and 138 reports simplified reports relating to General aviation or Aerial work.

| Events that led to the publication of an ICAO report in 2016 | | | | | |
|--|----------------------------|----------------------------------|-----------------|--|---------------------------|
| Registration | Type of aircraft | Place | Date of event | Type of event | Number of recommendations |
| F-GLOT & F-GUMI | MUDRY CAP21 MUDRY CAP10 | Argenton-sur-Creuse (36) | 1st August 2013 | Mid-air collision on aerodrome circuit | 1 |
| HB-JFN | DASSAULT FALCON7X | Subang AD (Malaysia) | 24 May 2011 | Horizontal stabilizer runaway in normal law during descent | 4 |
| D-AIPX | AIRBUS A320 | Prads-Haute-Bléone (04) | 24 March 2015 | Deliberate collision with the relief | 11 |
| OE-FKG | PIPER PA31T | Toulouse Blagnac (31) | 28 October 2011 | Traction dissymmetry, loss of control on final approach, collision with the ground, fire | 5 |
| N129AG | SOCATA TBM700B | Saint-Jean-les-Deux Jumeaux (77) | 6 August 2014 | Loss of control in flight, flat spin, collision with the ground | 2 |

Note: all BEA reports are published in French, but some of them are also published other language, most notably in English. In 2016, the BEA thus translated 15 final reports, including that on the D-AIPX event, which was translated into English, Spanish and German.

European Regulation 996/2010 specifies that an investigation report should be published as rapidly and if possible within the twelve months following the date of the event. For the BEA, a maximum length of twelve months for each investigation is thus a general objective and a monitoring indicator. This is defined as the ratio of the number of investigations closed within one year among the investigations initiated the previous year. The value of this indicator on 31 December 2016 was 0.52 (that's to say 82/156).

The tables below show the number of investigations closed in 2016, by types of event and operation. They also show the history of the events as well as investigations more than one year old that were not closed as of 31 December 2016.

| Investigations closed by the BEA in 2016 (by year of occurrence) | | | | | | | | | | | | | |
|--|-------------|----------|----------|----------|-----------|----------|----------|-----------|----------|----------|-----------|----------|------------|
| Event year | Before 2014 | | | 2014 | | | 2015 | | | 2016 | | | Total |
| | CAT | GA | AW | CAT | GA | AW | CAT | GA | AW | CAT | GA | AW | |
| Accidents | 1 | 6 | 0 | 3 | 25 | 2 | 1 | 65 | 4 | 1 | 31 | 1 | 140 |
| Serious incidents | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 8 |
| Incidents | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 4 |
| Total | 3 | 7 | 0 | 4 | 26 | 2 | 1 | 66 | 5 | 3 | 33 | 2 | 152 |

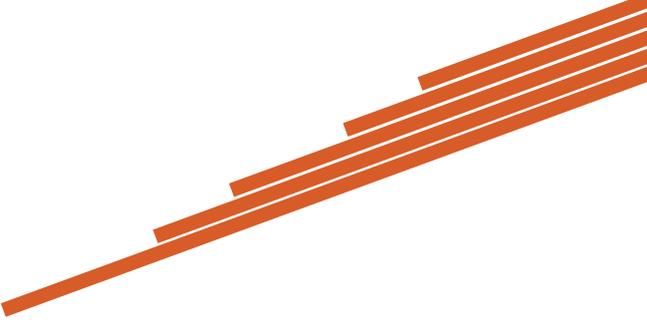
This table shows an increase in the number of investigations closed (152 in 2016 as against 136 in 2015).

One of the BEA's objectives is to maintain, as much as possible, a rhythm in which the number of investigations closed in each year N is greater than or equal to the number of investigations opened in year N-1, in order to limit the backlog of investigations under way to a reasonable level. This objective was practically reached in 2016 (152 closed against 157 opened in 2015). It should be noted that it had also almost been reached in 2015 (136 closed investigations in 2015 versus 139 investigations opened in 2014).

| Investigations undertaken by the BEA that had been open for more than one year as of 31 December 2016 | | | | |
|---|--------------------------|------------------|-------------|------------|
| | Commercial air transport | General aviation | Aerial work | Total |
| Accidents | 9 | 79 | 3 | 91 |
| Serious incidents | 11 | 9 | 0 | 20 |
| Incidents | 11 | 3 | 0 | 14 |
| Total | 31 | 91 | 3 | 125 |

After an increase in 2015, the number of investigations open for over a year stabilized: 125 in 2016, and 124 in 2015. The increase in 2015 was linked to the change in the BEA investigation policy on accidents to Annex 2 aircraft that led to an increase in the number of investigations on fatal accidents, which are in general longer than the investigations into material accidents. The decrease in the number of investigations initiated in 2016 leads us to hope that there will be a decrease in 2017 in the number of investigations under way and of the number of investigations open for over a year.





3 - GENERAL CONSIDERATIONS ON AIR SAFETY IN FRANCE IN 2016

3.1 Commercial air transport

In the operational context of commercial air transport, there was one accident that caused an injury (a ground assistant) in France, in 2016.

The serious incident occurred when safety margins seem to have been greatly reduced in relation to a loss of separation that occurred on approach to Marseille (13), on 27 June 2016, between a twin-jet and a helicopter. The investigation is continuing.

As previously mentioned, 2016 was also notable for the first investigations on the risk of mid-air collisions with drones, in particular with commercial transport aircraft. The 2 serious incidents investigated were the subject of a common investigation report, published on the BEA¹ website.

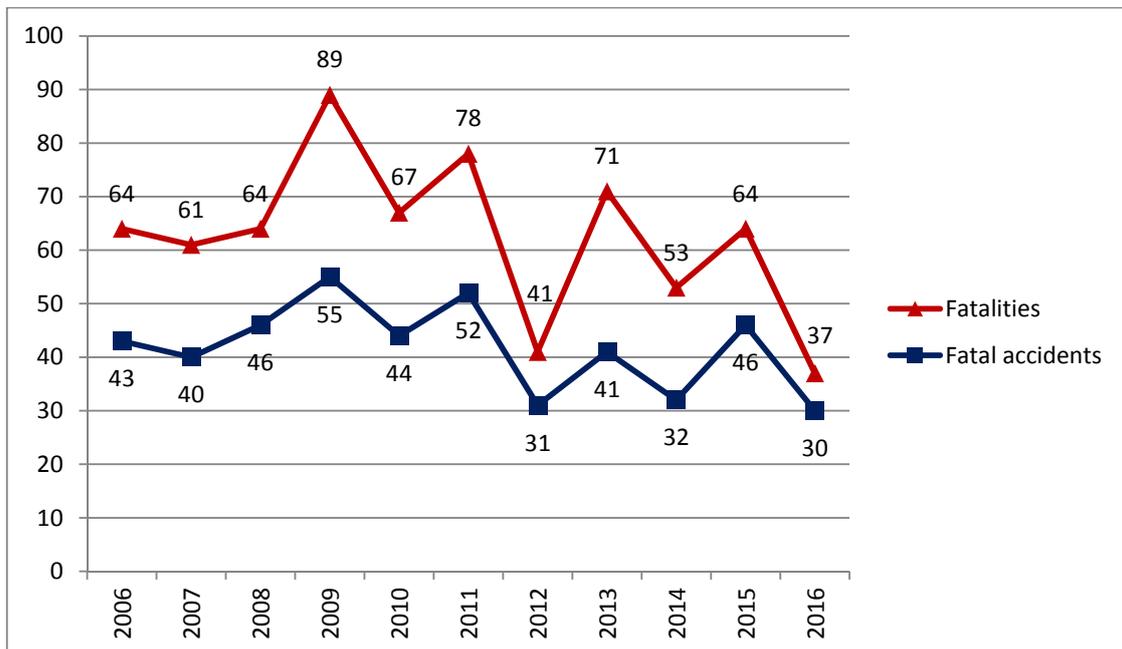
3.2 General aviation

3.2.1 General aviation, all activities

Concerning general aviation (all activities together), 2016 saw a fall in the number of fatal accidents. In fact, the figures are the lowest observed for over ten years.

There were:

- ❑ 30 fatal accidents (versus 46 in 2015 and 40 per year on an average from 2013-2015);
- ❑ 37 fatal injuries (versus 64 in 2015 and 63 per year on an average from 2013-2015).



Evolution from 2006 - 2016 in fatal accidents in general aviation (all activities included)

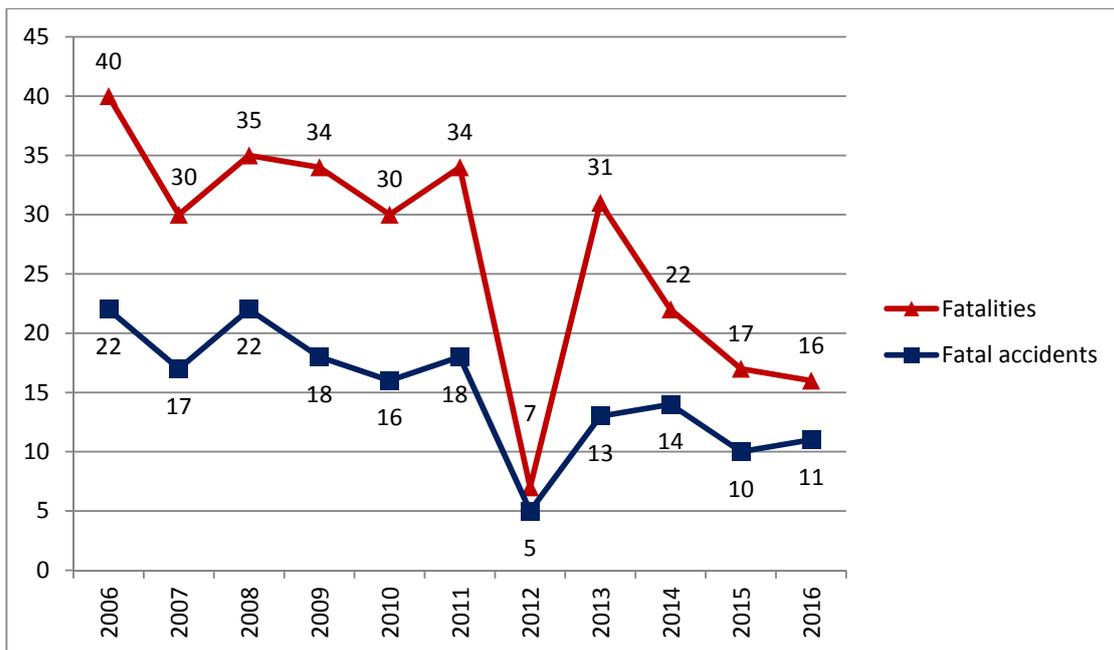
1 https://www.bea.aero/uploads/tx_elydrapports/BEA2016-0098.pdf

3.2.2 General aviation: Aeroplanes

The number of fatal accidents in general aviation involving aeroplanes is relatively stable compared to the previous three years. On the other hand, while the number of fatalities was comparable to 2015, it was sharply lower than in 2013 and 2014.

There were:

- 11 fatal accidents, versus 10 in 2015, 14 in 2014 and 13 in 2013 (and 12 per year on average over the period from 2013 – 2015). Apart from 2012, which was exceptional, the number of fatal accidents in 2016 was the lowest observed over the past 10 years.
- 16 fatalities, versus 17 in 2015, 22 in 2014 and 31 in 2013 (and 23 per year on average over the period from 2013 – 2015).



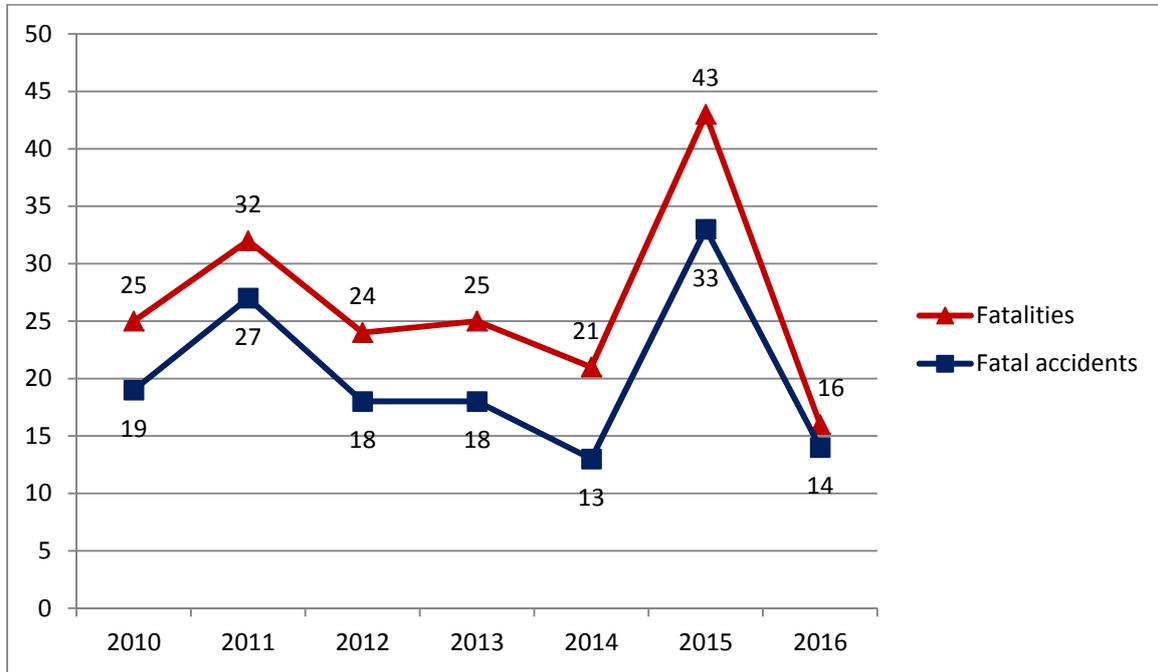
Evolution from 2006 - 2016 in fatal general aviation accidents (aeroplanes only)

From the qualitative perspective, it is notable that 5 of the 11 fatal accidents were linked to a form of determination to continue the flight towards the planned destination, despite meteorological conditions unfavourable for visual flight.

Among the other fatal accidents, 4 were due to loss of control, occurring on takeoff (two cases), on go-around or while flying low.

3.2.3 General aviation: Microlights

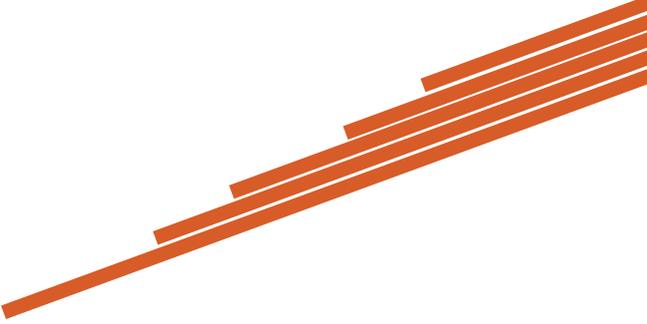
Concerning microlight activity, after a year in 2015 that was marked by a significant increase in the number of fatal accidents, 2016 was comparable to the years before 2015, and it should be noted that the number of fatalities is the lowest recorded since the beginning of the decade.



Evolution from 2006 - 2016 in fatal general aviation accidents (microlights only)

Among the 14 fatal accidents in 2016, there were 5 losses of control after a shutdown or decrease in engine power, which occurred mainly on takeoff. Four of these accidents involved multi-axis microlights.

In addition, there were five in-flight losses of control unconnected, a priori, to technical malfunctions (we note however that, investigations into these events being ongoing as of the date of this report, their conclusions are not yet definitive). Among these losses of control, two occurred during takeoff and two others during manoeuvres.



4 - SAFETY RECOMMENDATIONS

4.1 Overview

For the International Civil Aviation Organisation (ICAO), a safety recommendation is a proposal made by an investigation authority on the basis of information course gathered from an investigation or a study, in order to prevent accidents or incidents.

The BEA sends most of its recommendations either to the civil aviation authority of a State or to the European Aviation Safety Agency (EASA). Some recommendations may also be sent to operators, manufacturers etc. They must relate to the measures to be taken to prevent occurrences with similar causes.

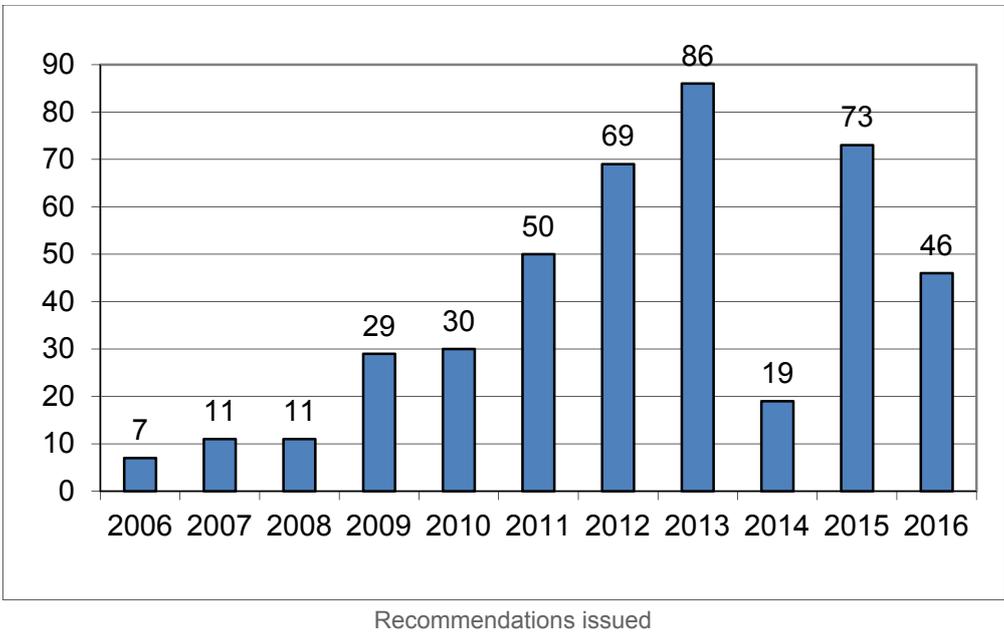
Follow-up on Safety Recommendations

The provisions of European regulation (EU) 996/2010 of the European Parliament and Council of 20 October 2010 on investigations and the prevention of civil aviation accidents and incidents makes mandatory, for Member States, that recipients of safety recommendations acknowledge receipt and inform the issuing authority, responsible for investigations, of the measures taken, or under consideration.

This response must be addressed to the issuing authority within 90 days of receipt of the Safety Recommendation letter. This authority then has 60 days to make known to the recipient of the Safety Recommendation if it considers its response as adequate or, if it disagrees with the answer, to communicate the reasons for this.

4.2 Safety recommendations issued

In 2016, the BEA issued 46 recommendations.



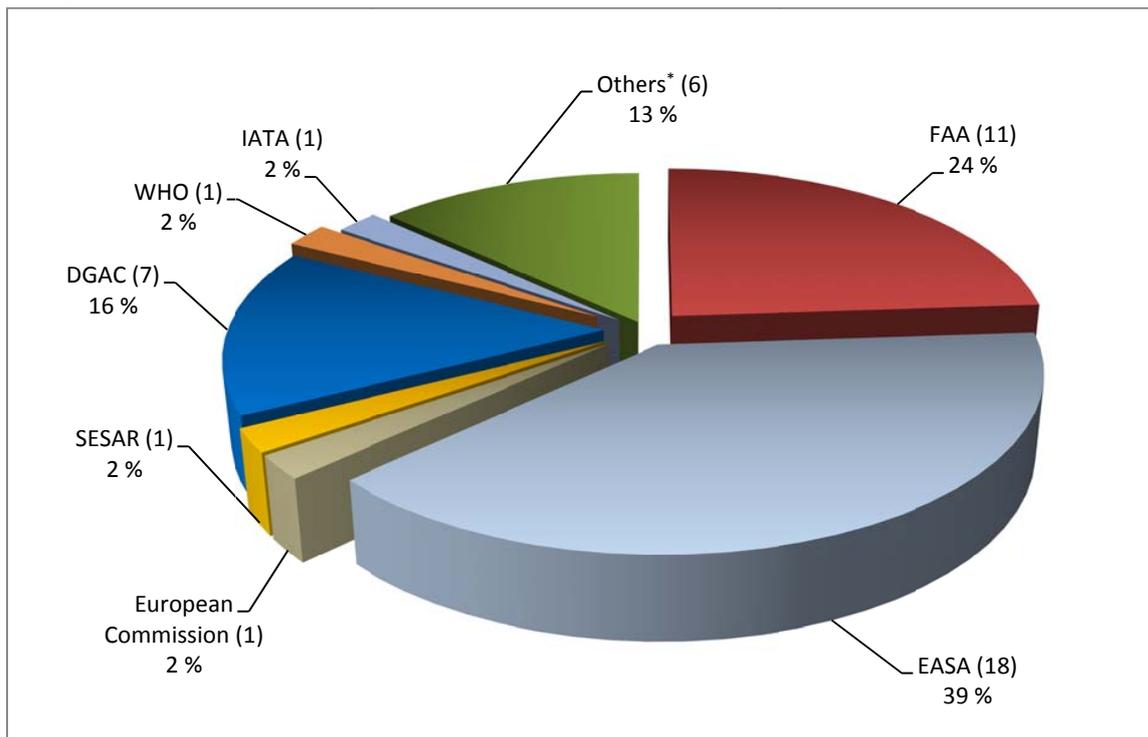
4.2.1 Breakdown by addressee

In 2016, EASA remained the main addressee of recommendations, followed by the United States Federal Aviation Administration (FAA).

In addition BEA addressed:

- ❑ a safety recommendation to each of the following European and international organisations: European Commission, Single European sky ATM research (SESAR) program, World health organization (WHO) and International air transport association (IATA);
- ❑ eight safety recommendations to two European Union Member State civil aviation authorities (French DGAC and Italian civil aviation authority);
- ❑ two recommendations to German organisations (one to the Federal Transport Ministry -BMVI-, and the other to the Medical Council - BÄK);
- ❑ a safety recommendation to the civil aviation authorities of Mali, Niger and Burkina Faso.

As in the previous year, it should be noted that in 2016, no recommendations were made directly to aeronautical manufacturers.



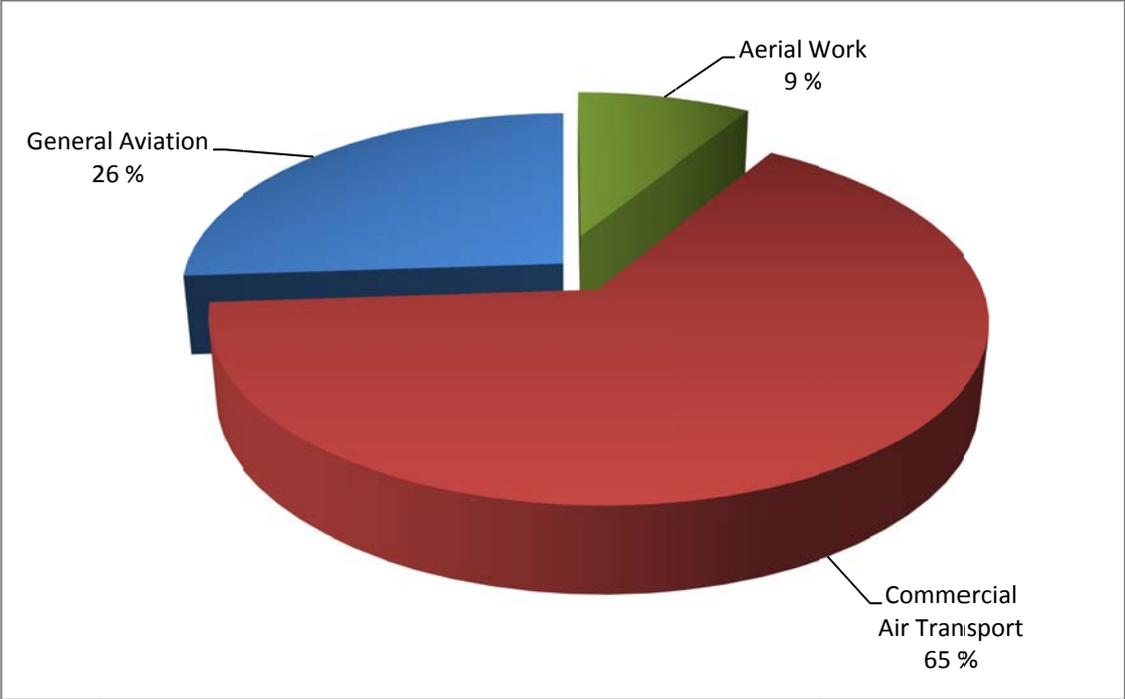
Addressees of recommendations

(*): Italy (ENAC), Germany (BMVI and BÄK), Mali, Niger, and Burkina-Faso

4.2.2 Distribution by type of operation

The majority (65%) of the recommendations issued in 2016 concerned the events linked to commercial air transport operations.

This rate is 16% lower in comparison to the previous year. However, the proportion of recommendations related to aerial work (AW) is three times greater than in 2015, and that relating to recommendations involving general aviation increased by 10%.

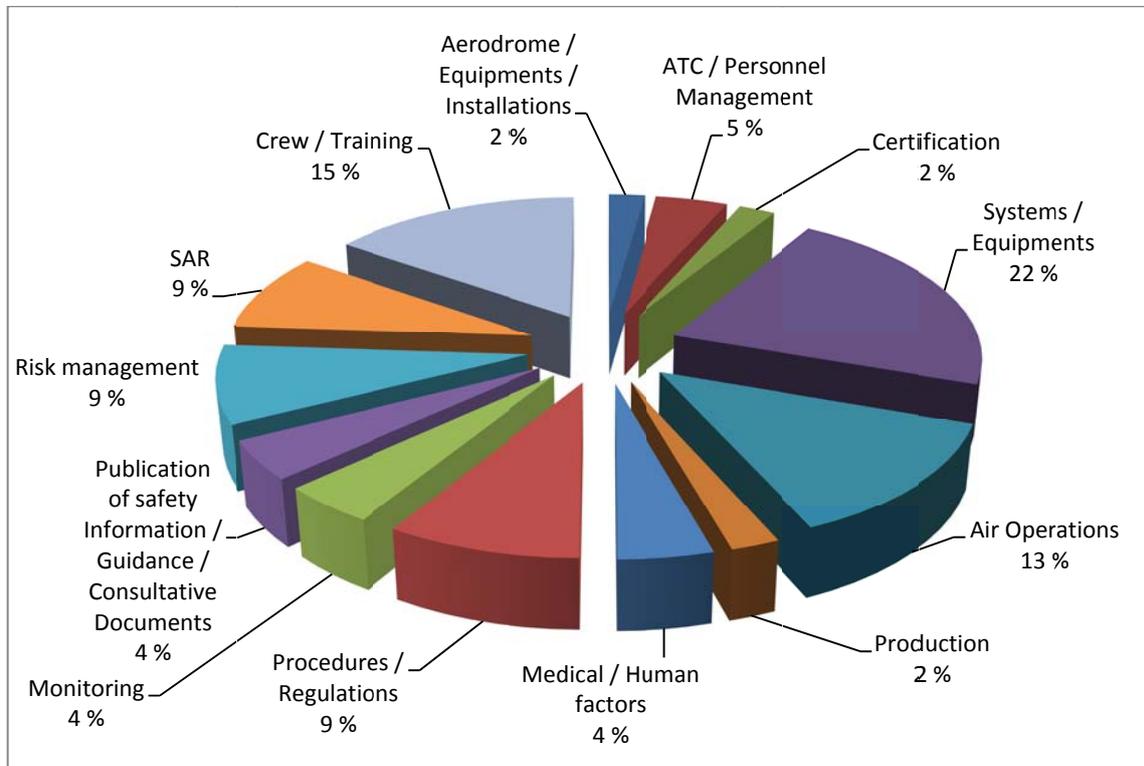


Breakdown by type of operation

4.2.3 Themes of recommendations

The breakdown of recommendations by theme issued in 2016 indicates thirteen areas in which safety actions were recommended.

The breakdown is as follows:



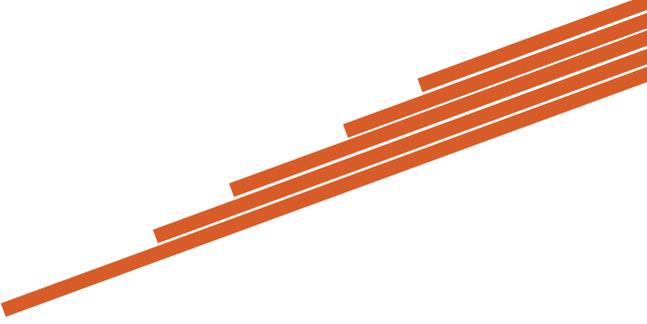
Breakdown by theme

4.3 Responses to Safety Recommendations

As regards follow-up to the 46 recommendations issued by the BEA in 2016:

- 1 recommendation received a favourable response from the German authorities addressed;
- 3 recommendations received a partially favourable response;
- 2 recommendations received an unfavourable response;
- 1 recommendation was considered by its addressee as already implemented;
- 17 recommendations received a response indicating that action was under way, by the addressees;
- 22 recommendations are pending a response from the addressee authority.





5 - LABORATORY ACTIVITY (ENGINEERING DEPARTMENT)

5.1 Overview of Engineering Department Activity 2016

The volume of activity of the Engineering Department was at a level close to that of previous years, with however a significant increase in the number of flight recorders read out compared with previous year.

Among the events that led to the highest workload were the accident to an EC225 helicopter in April 2016 in Norway, the accident to an A320 in May 2016, the accident to a B737-700 in August 2016 in the USA, involving a CFM56-7 engine and the accident to an ATR-42 in Pakistan in December 2016.

5.2 Flight recorders and avionics systems branch

5.2.1 Flight recorders

In 2016, 30 CVR recordings and 47 flight data recordings were read out and analysed at the BEA (versus 22 and 35 respectively the previous year). More than half of these recordings concerned investigations in which the BEA participated as accredited representative. Some work was also done in the context of technical assistance. In addition 9 QAR recordings were also read out.

In total, the number of recordings handled increased in comparison with previous years.

| | BEA investigation | BEA ACCREP | Technical assistance | Total |
|--------------------------------|-------------------|------------|----------------------|-------|
| CVR recordings read out at BEA | 5 | 18 | 7 | 30 |
| FDR recordings read out at BEA | 4 | 34 | 9 | 47 |

5.2.2 Avionics systems

In 2016, the BEA's avionics lab read out and analyzed 37 GNSS computers (satellite positioning system that associates various different systems with worldwide coverage including the American GPS system) and 83 onboard computers, to which can be added work on audio/video and tablet/smartphone recordings. With a total of 152 examinations (versus 137 the previous year), the activity of the avionics lab was very intense. The increase in work on photo/video was high, almost doubling.

| | BEA investigation | BEA ACCREP | Technical assistance | Total |
|------------------------|-------------------|------------|----------------------|-------|
| Avionics systems | 45 | 33 | 5 | 83 |
| GNSS | 26 | 4 | 7 | 37 |
| Smartphones / Tablets | 6 | 2 | 0 | 8 |
| Photo/video recordings | 11 | 12 | 1 | 24 |

5.2.3 ATM Recordings

In 2016, 48 events led to work on ATM (Air Traffic Management) data, based on radar data or Air Traffic Control communications. This type of work mainly relates to investigations led by the BEA and the level of this activity was comparable to that of the previous year.

ATM work by type of investigation was split as follows:

| | BEA investigation | BEA ACCREP | Technical assistance | Total |
|------------------|-------------------|------------|----------------------|-------|
| Number of events | 45 | 3 | 0 | 48 |

5.2.4 Development work at the avionics branch

The laboratory has been provided with new flight recorder readout equipment. The BEA is in fact trying to acquire, year after year, the means to make it possible to read out new models of recorders, when these are destined to be installed on the aeroplanes or helicopters of manufacture or operated by French operators. Notable acquisitions included equipment to read out L3COM FA2100 new generation recorders (NAND type memories) which are installed on the long-haul fleet, as well as for Curtiss-Wright MPFR recorders, which are installed on heavy helicopters in France and abroad.

The BEA avionics lab’s capacity was increased, specifically through the development of software making it possible to deal with corrupted files taken from damaged electronic systems, and by improving its tools for diagnostics and the readout of electronic cards and components.

The engineering department is developing tools to read out images from onboard video recordings. These tools will make it possible to stabilise images, recognise basic instruments (needles, horizon, lights and digital displays) and transform them into engineering data.

5.3 Structure, equipment and engines branch

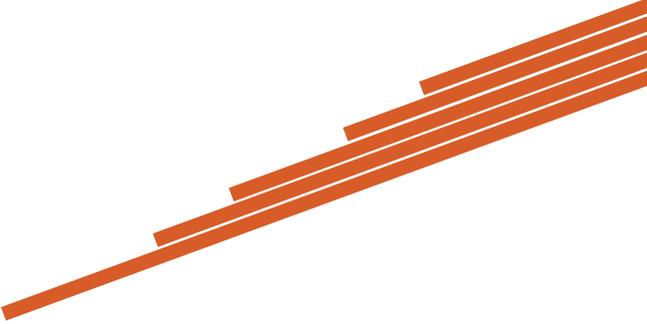
142 examinations were performed in 2016 of which 27 were in the context of accredited representation. These figures show a slight increase compared to the previous year, when there were 129 examinations of which 19 were in the context of accredited representation.

The examinations performed were split as follows:

| | BEA investigation | BEA ACCREP | Technical assistance |
|------------------------|-------------------|------------|----------------------|
| Wreckage examinations | 47 | 5 | 0 |
| Engine examinations | 24 | 1 | 0 |
| Equipment examinations | 41 | 21 | 3 |
| Total | 112 | 27 | 3 |

For two years, the engineering department has been developing its ability to carry out internal work on piston engines and their propellers, in the field of general aviation and microlights, for the most common 2 to 6 cylinder engines. Among these developments, a test bench for magnetos and sparkplugs, which is now operational, was constructed in 2016.

In addition, the materials and failure analysis laboratory continued its development of tools for RX tomography and also acquired new metrology equipment making it possible to perform dimension checks.



6 - COMMUNICATION, INTERNATIONAL ACTIVITIES, PUBLIC RELATIONS AND ASSISTANCE TO FAMILIES

The BEA undertakes a wide range of activities on the European and international scene: communication activities through its participation in international conferences, setting up cooperation agreements with foreign investigation organisations, leading training seminars abroad and participating in working groups in international organisations (in particular the European Union, ECAC and ICAO). In addition, the BEA has a duty to inform victims of aviation accidents or their families. This duty is mentioned in European Regulation (EU) 996/2010.

6.1 Communication activities

Every year, the BEA participates in several conferences and expert meetings. This allows the BEA not only to spread safety messages that result from investigations that it leads or participates in, but also to make its expertise more widely known abroad. This reputation is an essential tool in succeeding in its interventions during investigations abroad.

In 2016, the BEA thus participated in the following international conferences:

- ❑ **International Society of Air Safety Investigators (ISASI), in Reykjavik (Iceland)**
The BEA presented the safety investigations that it led into both an event that occurred to a Falcon 7X (this investigation specifically raised issues relating to complex aircraft certification procedures) and into the accident that occurred on 24 March 2015 in the French Alps to the Airbus A320 operated by Germanwings.
 - ❑ **Asian Society of Air Safety Investigators (AsiaSASI), in Tokyo (Japan)**
The BEA presented in conjunction with the Indonesian investigation authority the results of the investigation into the accident to an Air Asia Airbus A-320 on 28 December 2014 in the Java Sea.
 - ❑ **Middle East Society of Air Safety Investigators (MENASASI) in Rabat (Morocco)**
The BEA presented its activities in the field of international cooperation through accredited representation and the activities of ACC group of investigation authorities.
 - ❑ **AIR meeting (Accident Investigators on Recorders)**
This annual meeting of flight recorder specialists from of the investigation authorities worldwide was organised this year by the BEA on its premises.
 - ❑ **AIM meeting (Accident Investigators on Metallurgy), in London (United Kingdom)**
This meeting groups together metallurgy specialists from of the investigation authorities worldwide.
 - ❑ **GA-ASI (General Aviation Air Safety Investigators) in Wichita (United States)**
This annual conference groups together investigators and industry, in the area of general aviation. This year the BEA presented the work it has done, specifically related to analysis landing roll behaviour, based on the safety investigation into a runway excursion by a Gulfstream G-IV at Le Castellet on 13 July 2012.
- IATA Conference (International Air Transport Association) in Hong Kong**
The BEA presented in conjunction with the NTSB a paper on managing communication in a major investigation.

6.2 Collaboration with foreign investigation organisations

Through its experience and know-how, the BEA is recognized as one of the most important safety investigation authorities. As such, it is regularly consulted by many States for assistance involving oversight of implementation of standards and practices recommended by ICAO. It was in this context that in 2016 the BEA signed two Declarations of Intent for Cooperation in investigations civil aviation accidents, respectively with Romania and with Senegal. This approach proposes assistance, within the bounds of reasonable limits, in case of a major investigation. It should be noted that, with regard to Romania, this principle of cooperation is part of the logical assistance procedures promoted by ENCASIA (European Network of Civil Aviation Safety Investigation Authorities) and mentioned in article 7 of European Regulation (EU) No 996/2010.

6.3 Training actions

In 2016, the BEA organised, on its premises, two Basic Investigation Techniques training courses. These courses, which lasted two weeks, are mainly intended to provide initial training for investigators recently recruited by the BEA and for Field Investigators (see paragraph 7.1.1. below), but they are also open to other trainees (Gendarmerie, industrial concerns, etc.). This autonomous organisation is a first: until 2015, it was undertaken in collaboration with other organisations, and in several places. The experience having been positive, it will be repeated in future years.

The BEA led a training course on the investigation method and techniques specific to the case of a commercial air transport accident. This 15-day training course took place on the BEA's premises. It brought together safety investigators from the Democratic Republic of the Congo and investigators from airlines and French manufacturers. The content of this training course anticipated the phase 3 training course that will be used for BEA investigators that have already completed a basic training and have experience in the field, and will in future allow the BEA to set up a standardised training curriculum, for its own needs as well as for those of international and French industrial partners.

6.4 Participation in the work of international organisations

6.4.1 ICAO

The BEA participates in the ICAO Flight Recorder Specific Working Group (FLIREC-SWG), and holds the presidency thereof. The work of this group made possible the publication of new modifications to Annex 6 on following aircraft above ocean area and the rapid recovery of flight data. These modifications, which have been actively supported by the BEA, specifically correspond to the recommendations published in the context of the safety investigation into the accident to the A330 registered F-GZCP and operated by Air France crashed into the Atlantic Ocean, flight AF447 Rio-Paris.

In addition, following the investigations into the accidents to flights AF447 and MH370, ICAO is undertaking a lot of work in the context of various working groups. The BEA participates actively in one of them, whose objective is to propose writing a new version of the document defining the General Aeronautical Distress and Safety System (GADSS).

The BEA also participates in the ICAO Accident Investigation Group Panel (AIG: this group of experts works to propose amendments to Annex 13. In 2016, it made a specific proposal to better handle situations where the country responsible for leading an investigation does not initiate an investigation or does not publish investigation report.

Finally, a working document aimed at improving oversight and recording of steps taken following safety recommendations was prepared by the BEA and presented by France, during the 39th ICAO assembly.

6.4.2 European Union

European Regulation (EU) 996/2010 set up a structure called ENCASIA (European Network of Civil Aviation Safety Investigation Authorities) to coordinate the work and experience of the various investigation authorities in the European Union. The BEA participates actively in the work of this network. In this context, it is a major participant in the conduct of peer reviews between European investigation authorities, as well as in identifying, formalizing and sharing best European practices with regard to investigations and the writing of reports. It also actively contributed to the workshop organised on the risks at an accident site.

6.4.3 ECAC (European Civil Aviation Conference)

The investigations authorities group of the 44 Member States of the European Civil Aviation Conference (ECAC) is a feedback forum. The Director of the BEA was named Vice President of this group and presided over a meeting, organised in 2016 in Vergiate (Italy), during which industrial organisations were working with investigators on safety investigation activities on helicopter accidents.

6.4.4 RASG-EUR (Regional Aviation Safety Group Europe)

This group is intended to foster coordination between States, regional organisations and the industry, with the main aim of supporting the implementation of the Global Aviation Safety Plan (GASP) in the 44 ECAC Member States. The BEA has participated in this group in developing common provisions in all States.

6.4.5 APAC/AIG and SAM/AIG

The Accident Investigation Groups of Member States in Asia and the South Pacific (APAC-AIG) and South America (SAM-AIG) are forums for feedback and exchange similar to that of the ACC in Europe. France is a Member of APAC-AIG (as the investigation authority for French Overseas Territories) and participated at its fourth meeting, which took place in Tokyo in 2016. In addition it was asked by Argentina to participate as a special observer in the third meeting of SAM-AIG that took place in Lima.

6.4.5 EUROCAE (EUROpean Organisation for Civil Aviation Equipment)

This European organisation, which groups together members of the aviation community and publishes reference documents on specifications for onboard systems. The BEA has participated for several years in the work of a number EUROCAE working groups, in particular those dealing with updating the specifications for flight recorders (such as image recorders or ejectable recorders). EUROCAE WG-98 is currently headed by the BEA representative: this group aims to define the specifications for triggering position transmission when an emergency situation is detected automatically by the onboard aircraft systems. Some of the specifications come from recommendations of the investigation into the accident to the Rio-Paris flight AF447. The results of this work have been taken up in ICAO Recommended Standards and Practices, Which were published in November 2016.

6.4.6 International Transport Safety Association (ITSA)

ITSA is a group that organises meetings and information exchange between independent investigation organisations, which initially grouped together only multimodal investigation organisations. Although it is not multimodal, the BEA has participated for several years, in view of its significant international role. The BEA hosted its annual meeting in 2016, during the course of which it was able to offer its counterparts a close-up view of the results and specific issues in the safety investigation into the accident that occurred on 24 March 2015 in the Alps, to the Airbus A320 operated by Germanwings flight 4U9525, as well as the context of the interactions between the safety investigation and the criminal investigation in France.

6.5 Information to families

In 2016, nine meetings were organised for the families of victims to present the progress and the conclusions of the safety investigation.

Three meetings involved commercial air transport accidents that occurred in 2014 and 2015 ; six meetings involved general aviation accidents that occurred between 2013 and 2016.

It should be noted that these meetings did not only involve accidents for which the BEA led the safety investigation itself.

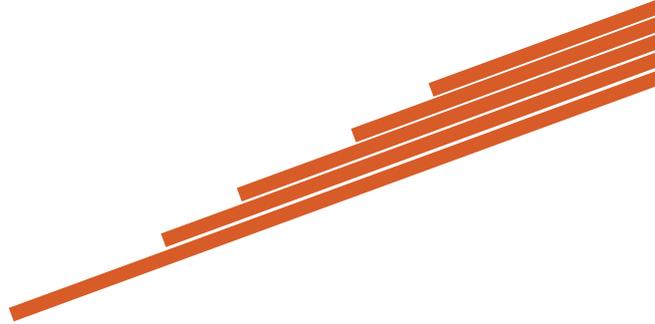
Thus, there were:

- ❑ six meetings on five investigations that it undertook into accidents that occurred in France. Among these, we may mention the two simultaneous meetings for the presentation of the final report on the flight 4U9525 event to the families and friends of the victims. These meetings were organised in Germany and in Spain with the assistance of the BFU and the CIAIAC, the German and Spanish counterparts of the BEA;
- ❑ three meetings on three investigations in which it participated for accidents that occurred abroad. For the latter, the presentations to the French victims' families were organised with the agreement of the authorities in charge of the safety investigation.

In addition, the BEA participated in three information meetings for victims' families from the accident to flight MS804 Paris – Cairo, as well as in a meeting organised by the SHK, the Swedish counterpart of the BEA, relating to a general aviation accident that occurred in 2016.

Finally, the BEA met, at the BFU's premises, the association for the German victims' families from flight AF447 Rio – Paris.





7 - HUMAN RESOURCES, FINANCE

7.1 Personnel

7.1.1 As of 31 December 2016

As of 31 December 2016, the BEA had 94 agents divided as follows:

| BEA staff | Public servants | Contractual employees | Workers | Total |
|----------------------|-----------------|-----------------------|-----------|-----------|
| Flight crew | - | 1 | - | 1 |
| Engineers | 42 | 9 | - | 51 |
| Senior technicians | 14 | - | - | 14 |
| Workers | - | - | 11 | 11 |
| Administrative staff | 14 | 3 | - | 17 |
| Total staff | 70 | 13 | 11 | 94 |

Note: to the staff listed above should be added 151 Field Investigators. These investigators, trained by the BEA, act at its request and under its control and authority, in general in the context of general aviation accident investigations. They are usually agents from DGAC services, more precisely the inter-regional DSACs. They operate under the terms of a service contract between the BEA and these services.

7.1.2 Personnel Training

The BEA spends a significant part of its budget on professional training in order to guarantee a high level of skills for its personnel in various areas, indispensable to its activity.

Thus in 2016, the budget devoted to professional training was 237,163 € for the 96 agents involved (thus about 8% of the annual budget). There were 232 training courses undertaken over 663 days, which meant an average of 6.9 days of training per agent.

The training courses representing more than 30 persons for X days a year are in the following areas: language training (mainly English), technical training courses with specialised organisations related to investigations, manufacturers' training courses and flying training. It should be noted that in 2016, an agreement was signed between the BEA and an airline to allow an agent, type rated on passenger planes, to periodically undertake commercial air transport flights. The BEA would like to develop this type de agreement, which is aimed at acquiring and maintaining experience: the objective is, over time, to assist three or four agents to maintain this type of qualification.

7.2 The budget

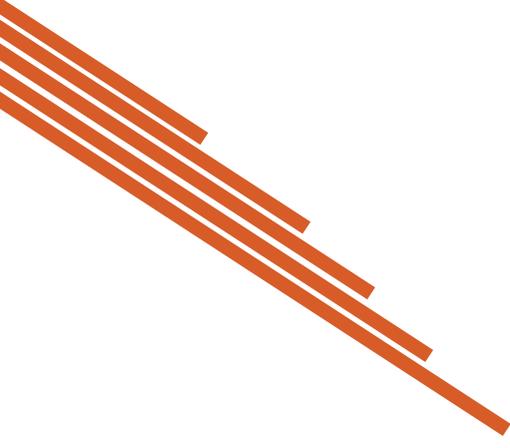
7.2.1 Allocations

The BEA budget for 2016 was set in the initial finance law at 2,905 M€ in commitment authorisations (CA) and payment appropriations (PA).

This budget received an additional allocation during the year, of a total of 0.3 M€ in CA and in PA: this redistribution of credits within the 614 programme for air transport, oversight and certification, was made in order to partially finance the sea search operations related to the accident to the Egyptair A320. The rest of the operation, whose total cost was 0.56M €, was financed by the BEA's initial annual allocation.

7.2.2 Expenditure during the period

| Services | OPERATIONS | | INVESTMENT | |
|-----------------------|------------------|------------------|---------------|---------------|
| | AE (€) | CP (€) | AE (€) | CP (€) |
| Communication | 30 714 | 49 811 | 0 | 0 |
| Logistics | 927 634 | 867 779 | 5 304 | 12 024 |
| Engineering | 786 220 | 775 151 | 63 443 | 35 000 |
| Investigation support | 28 105 | 29 886 | | |
| Computing | 299 090 | 316 427 | 9 586 | 34 486 |
| Training | 240 380 | 231 412 | 0 | 0 |
| Travel | 771 479 | 771 387 | 0 | 0 |
| Total (€) | 3 083 622 | 3 041 853 | 78 333 | 81 510 |



Safety, together



BEA_____

Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile



Aéroport du Bourget
Zone Sud - Bâtiment 153
10 rue de Paris
93352 Le Bourget Cedex France
Tél. : +33 1 49 92 72 00
Fax : +33 1 49 92 72 03

Juillet 2017