Airbus A320 wingstrike at Hamburg Airport going around the world within hours via YouTube.

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On 1 March 2008 an Airbus A320 on a scheduled passenger flight from Munich to Hamburg experienced high and variable wind velocity on short final and during the attempt at landing on runway 23 with a strong crosswind component from the right, the left main landing gear touched down followed by a left wing down attitude which resulted in the left wingtip touching the ground. A go-around was initiated and after radar vectoring, a second approach to runway 33 was made to a successful landing. No aircraft occupants were injured but the aircraft left wing tip was found to have been damaged by the runway contact.

A plane spotter video taken on the ground and distributed via internet within the next hour after the occurrence resulted in a media hype. Several television programs picked up the video for their evening newscasts and newspapers reported about the event. Especially the "yellow-press" produced one headline after the other. Initially, the press praised the pilots for their "heroic" reaction. Then, they started to doubt this version and asked why the pilots didn't use a different runway at the airport in the first place, one that was better suited for landing in strong winds? When the media realized that the 24 years old female copilot flew the aircraft they asked why the inexperienced copilot was on controls in such bad conditions and not the captain himself? Later on a weekly magazine revoked a pilots' fault. Airbus's fly-by-wire system was blamed for causing the serious incident. The prejudgments have been strengthened by several statements given by self-appointed professionals.

Figure 1: Wingtip contact with the runway

In conformity with the Federal German Law Relating to the Investigation into Accidents and Incidents Associated with the Operation of Civil Aircraft (*Flugunfall-Untersuchungs-Gesetz - FlUUG*), the German Federal Bureau of Aircraft Accident Investigation (BFU) classified the occurrence as a 'Serious Incident' and opened a formal investigation.

The BFU finalized a comprehensive investigation by publishing the final report including twelve safety recommendations in May 2010.

The Investigation found that "this serious landing incident took place in the presence of a significant crosswind and immediate causes are as follows:

- The sudden left wing down attitude was not expected by the crew during the landing and resulted in contact between the wingtip and the ground.
- During the final approach to land the tower reported the wind as gusting up to 47 knots, and the aircraft continued the approach. In view of the *max. demonstrated crosswind for landing,* a go-around would have been reasonable.

The following systematic causes led to this serious incident:

- The terminology *maximum crosswind demonstrated for landing* was not defined in the Operating Manual (OM/A) and in the Flight Crew Operating Manual, Vol. 3, (FCOM), and the description given was misleading.
- The recommended crosswind landing technique was not clearly described in the aircraft standard documentation.
- The limited effect of lateral control was unknown."

The investigation showed that wingtip contact with the runway was not due to a single human error, a malfunction of the aircraft or inadequate organisation; rather, it was due to a combination of several factors.

The approach was stable up to about eight seconds before touchdown. Given the effect of the wind, the sidestick inputs were logical.

The comprehensive factors and the following analysis are mentioned in the final report[1]. A major influence was given by the weather situation and the decision-taking processes.

Operational Aspects:
Because of the weather associated with hurricane Emma, on 1 March 2008 the Airbus A320 left Munich Airport on a scheduled flight to Hamburg at 1231 hrs[2] on about two hours behind schedule, with a crew of five and 132 passengers. Given the ATIS (Automatic Terminal Information Service) weather report including wind of 280°/23 kt with gusts of up to 37 kt, during the cruise phase of the flight the crew decided on an approach to Runway 23, the runway then also in use by other traffic. During the approach to land, the aerodrome controller gave several updates on the wind. Immediately prior to touchdown, the wind was reported as 300°/33 kt, gusting up to 47 kt. At the time of the decrab-procedure there no significant gust.

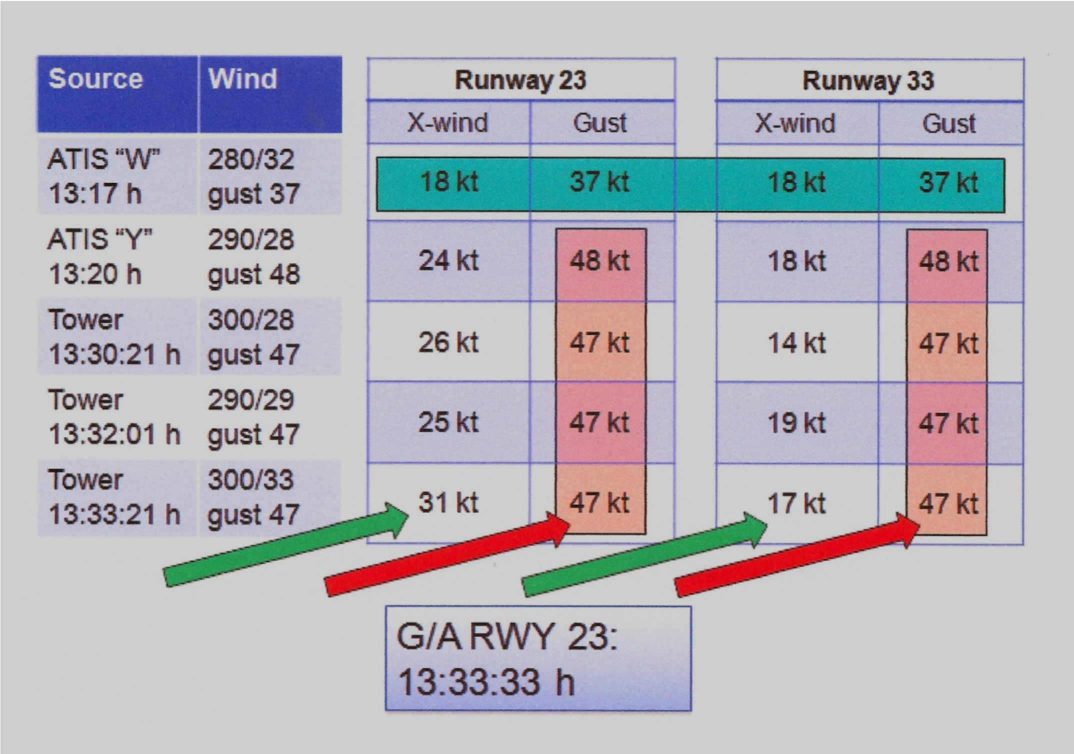
The initial descent was flown by autopilot and the co-pilot assumed manual control from 940 ft above ground.

After the aircraft left main landing gear had touched down, the aircraft lifted off again and immediately adopted a left wing down attitude, whereupon the left wingtip touched the ground. The crew initiated a go-around procedure. The aircraft continued to climb under radar guidance to the downwind leg of runway 33, where it landed at 1352 hrs.

The flight crew had wind information issued by ATIS and tower. The resulting wind components for runway 23 and runway 33 are shown in Figure 2.

[1] http://www.bfu-web.de/EN/Publications/Investigation%20Report/2008/Report_08_5X003_A320_Hamburg-Crosswindlanding.pdf?__blob=publicationFile

[2] Unless otherwise specified, all times are indicated in local time



Source	Wind	Runway 23 X-wind	Runway 23 Gust	Runway 33 X-wind	Runway 33 Gust
ATIS “W” 13:17 h	280/32 gust 37	18 kt	37 kt	18 kt	37 kt
ATIS “Y” 13:20 h	290/28 gust 48	24 kt	48 kt	18 kt	48 kt
Tower 13:30:21 h	300/28 gust 47	26 kt	47 kt	14 kt	47 kt
Tower 13:32:01 h	290/29 gust 47	25 kt	47 kt	19 kt	47 kt
Tower 13:33:21 h	300/33 gust 47	31 kt	47 kt	17 kt	47 kt

Figure 2: Wind data for Runway 23 and Runway 33

After the decision to approach runway 23 the latest wind information given by tower was 300/33 gust 47. The updates on wind before included gust with 47 kt.

According to the Operations Manual (OM/B) and the Flight Crew Operations Manual (FCOM) "33 kt gusting up to 38 kt" was defined for *maximum crosswind demonstrated for landing*.

The crew did not interpret the wording given in the Operations Manual instruction *“The steady crosswind and gust component for take-off and landing must not exceed the values specified in (the Operations Manual) Where no gust limit is specified, gust exceeding crosswind limitations must be considered whenever judged operationally significant.”* as a flight operational limit. The gusts were not viewed as a limiting factor.

BFU found that the aircraft certification method for setting the crosswind landing limits or guidelines, respectively, permitted a method of demonstrating compliance did not take into full account the real effect of crosswinds.

The values for *maximum crosswind demonstrated* were presented differently for different types within the Airbus family (average wind speed plus gusts, average wind speed including gusts).

For a better understanding why the flight crew did not view the maximum crosswind demonstrated for landing as a limiting factor, BFU initiated an anonymous questionnaire survey of airline pilots.

For clarification this investigation incorporated an anonymous survey of 81 ATPL-pilots currently employed by five different airlines. The objective of the survey was to establish how pilots understand the term *maximum crosswind demonstrated for landing* given in handbooks, and how this is interpreted in practice.

The survey was conducted by BFU personnel using a questionnaire and pilots were asked to provide spontaneous answers.

There were three questions, with possible answers provided. The answers given are represented by the following distribution diagrams.

Question 1:

What is the practical meaning for you in normal flight operations of the term "maximum demonstrated crosswind", as stated in OM/B?

a) This value is a limit.
b) This value is a guide.
c) Right now, I am not sure.

Answers:

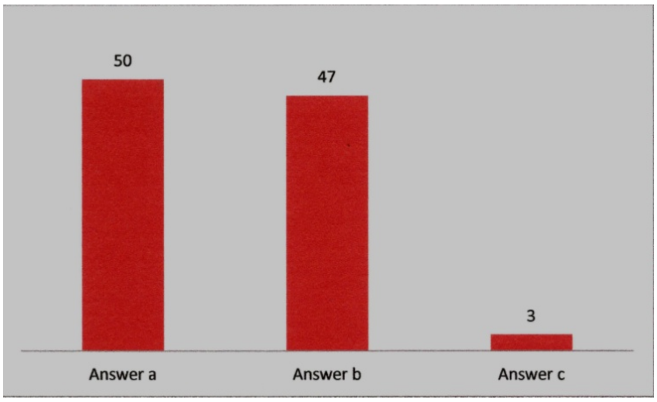


Figure 3: Percentage distribution of answers to question one

Question 2:

"Maximum demonstrated crosswind" is the

a) maximum crosswind speed at which the authority of control surfaces can be maintained during a crosswind landing.
b) maximum crosswind speed that could be demonstrated during Type Certification test flying, due to the weather conditions.
c) maximum crosswind speed that, following test flying, has been set as a representative limiting value for line pilots.
d) Right now, I am not sure.

Answers:

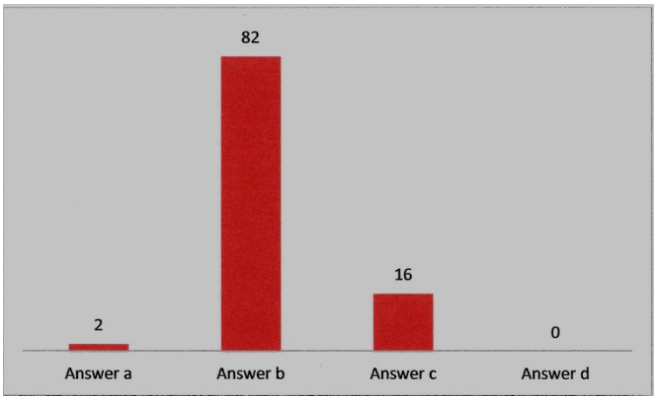


Figure 4: Percentage distribution of answers to question two

Question 3:

The handbook sets the "maximum demonstrated crosswind" at 33 kt, gusting 38 kt. The crosswind component (gust) for the approach is 40 kt. Which of the following responses is correct:

a) The aircraft may land, if the gusts are assessed as not operationally relevant.
b) The aircraft may not land, be-cause this would exceed the air-craft's operational limitations.
c) Gusts are not to be considered when calculating crosswinds, only the steady wind counts.
d) Right now, I am not sure.

Answers:

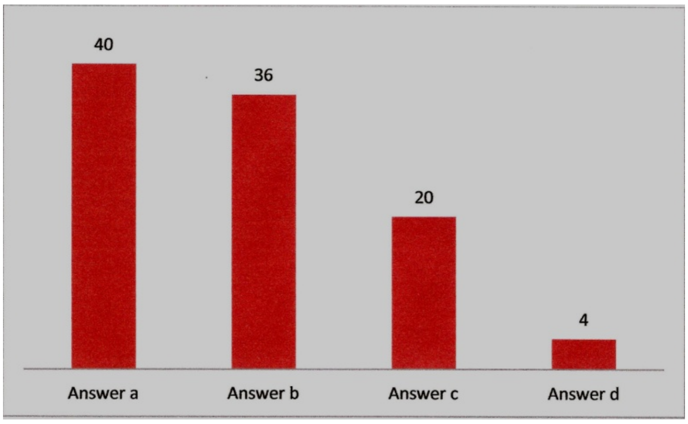


Figure 5: Percentage distribution of answers to question three

Due to the different interpretations of *gust data* and *maximum demonstrated crosswind for landing* the BFU issued amongst other safety recommendations following:

"EASA should place a contract with a suitable research institute (DLR, University or similar) to determine what measuring systems are suitable to detect the presence of near-surface gusts on airports, and how the resulting gust data and wind direction information should be processed and communicated to pilots. The results should lead to a process through which the information so obtained can be standardised and incorporated into the regulations governing air operations."

In response to the above-mentioned safety recommendation EASA assigned the NLR Transport Safety Institute to conduct a study regarding gust detection practices to support flight crew decision-making. The study[3] has been published in December 2011.

The BFU directed a further safety recommendation regarding *maximum crosswind demonstrated for landing* to the aircraft manufacturer which has been accepted as well.
The manufacturer should adopt a uniform presentation of *maximum crosswind demonstrated* for landing for the entire range of the same series of aircraft. The maximum crosswind demonstrated for landing should be described either as a dual value (average wind speed and gust) or as a single value (average wind speed including gusts). Manufacturers should make recommendations to air operators as to the suitable maximum crosswind component for landings.

Aircraft (Lateral control)
When the left main landing gear first touched the runway, the lateral control system condition (thus) met all the requirements for the transition from Flight Mode to Ground Mode, so the system switched from lateral Flight Mode to lateral Ground Mode even though the aircraft was once again in the air.
The aircraft was designed so that the effect of lateral controls (along the longitudinal axis) would reduce by about one half of full deflection as soon as one main landing gear touched down.
The reduced effect of controls was not documented in the system description and was unknown to pilots or the training department.

By now the Flight controls laws logic has been modified with a modification of transition from flight to ground lateral law. This improvement has been certified in 2012 in the ELAC standard L96 and is available through Service Bulletin ref 27-1225.

Landing Technique
The descriptions of different crosswind landing techniques (crab-angle, sideslip or a combination) contained in flight operations documentation FCOM, FCTM, FCOM Bulletins and FOBN were not uniform and in part contradictory.

[3] http://www.nlr-atsi.nl/downloads/analysis-of-existing-practices-and-issues-rega.pdf

The crosswind landing description given in FCOM was less suitable for use in very strong crosswinds, because it could result in the aircraft drifting from the runway centerline.
There were different descriptions given in the aircraft manufacturer's flight documentation with respect to the use of rudder in crosswind conditions.
One Flight Operation Briefing Note (FOBN) issued by the aircraft manufacturer described a technique for landing in strong crosswinds that would have been suitable for the Hamburg landing in question but it was not part of the official Operations Manuals.
The description of the crosswind landing technique given in the Company Operations Manuals did not correspond fully with the one given by the aircraft manufacturer in the FCOM.
There were differences between the landing techniques described the Operations Manual volumes covering ‘Aircraft Type’ and ‘Fight Training’; under strong crosswind conditions the wings *low with crabbed approach technique* described in the Flight Training volume would have been more suitable and was the method taught and practiced in the simulator.

In response to a safety recommendation regarding landing techniques the aircraft manufacturer has updated the descriptions of the different landing techniques and in addition to that reviewed the published Flight Operations Briefing Note (FOBN)[4] regarding crosswind landings.

Lessons Learned

The above-mentioned serious incident is a concrete example to demonstrate the importance to investigate serious incidents and not just accidents. Nevertheless limited resources and number of investigators do not allow all Safety Investigation Agencies to investigation serious incidents. It has not be unconsidered that the investigation of a serious incident can be very complex as well.

The aim of every investigation is to reveal and eliminate safety deficiencies in the daily aircraft operation. For this reason it is necessary to determine systemic causes and to issue final reports and safety recommendations. A follow-up to safety recommendations and a safety recommendations database is a helpful tool to improve safety for the future. A forward-looking example is the EU-Regulation 996/2010 where this requirement is laid down.

Nowadays photographs and videos taken by amateurs, passengers or security cameras at the airports are common practice. Videos showing the sequent of events can be helpful for investigators. However, if not taken properly, photographs and videos can easily misrepresent a scene and lead to false conclusions or findings about an accident.

Safety Investigation Agencies and safety investigator have to consider that photographs and videos taken by amateurs are interesting for media. The World Wide Web (WWW) including platforms like You Toube enables a global distribution of video and photographs within minutes. A media hype followed by misinterpretations and false conclusion are very likely.

[4] http://www.airbus.com/fileadmin/media_gallery/files/safety_library_items/AirbusSafetyLib_-FLT_OPS-LAND-SEQ05.pdf

To restrict a blame or prejudgment of pilots, airlines, manufacturer or other involved organizations it can be a good policy for Safety Investigation Agencies to support the media with assured factual information and official photographs as early as possible.

Preparing the Next Generation of Investigators

Recent accidents and serious incidents such as the Airbus A380 engine disintegration, the Boeing B777 multiple engine failure and the Airbus A320 crosswind landing at Hamburg airport are examples for complex occurrences and investigations. In addition to the complexity the media impact was eminent.

It is assumed that Safety Investigation Agencies and safety investigators have to deal with occurrences like above-mentioned. The complexity of the "system aviation" and the activities of journalist and media will increase more and more.

In respect of the ISASI 2013 seminar headline "Preparing the Next Generation of Investigators" it might be helpful to initiate two improvements (among other approaches):

1. To establish a global knowledge data base "From safety investigators for safety investigators". The repository of safety knowledge related to aviation safety in general can be a portal, a common entry point, that enables investigators to access data made available on the websites of safety investigation agencies, regulators, industry and other aviation organizations. The concept of Media-wiki products - anyone can comment, propose modification to an existing article, suggest a new topic or submit a draft article might be reasonable. A good example is the repository SKYbrary issued by Eurocontrol related to air traffic management (ATM) safety.
2. There is a need to improve education and training for future safety investigators. The common approach to hire experienced pilots, engineers, psychologists and ATM controller for safety investigator jobs is still appropriate. But, in addition to these assumptions it is necessary to setup a mandatory education in safety and accident investigation. The education should include theoretical and practical applications for the different functions like investigator, investigator in charge (IIC) and accredited representative (AccRep). The ICAO Circular 298 AN/172 (Training Guidelines for Aircraft Accident Investigators) might be a helpful guideline.