# Tenerife disaster

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Coordinates: 28.48165° N 16.3384° W

The **Tenerife disaster** took place on March 27, 1977, at 17:06:56 local time (also GMT), when two Boeing 747 airliners collided at Tenerife North Airport on the island of Tenerife, Canary Islands, Spain, killing 583 people. The accident still has the highest number of fatalities (excluding ground fatalities) of any single accident in aviation history.

The aircraft involved were **Pan Am Flight 1736**, named *Clipper Victor*, under the command of Captain Victor Grubbs, and **KLM Royal Dutch Airlines Flight 4805**, named *Rijn* (Rhine River), under the command of Captain Jacob Veldhuyzen van Zanten. KLM 4805, taking off on the only runway of the airport, crashed into the Pan Am aircraft which was taxiing on the same runway.

Tenerife North Airport (TFN) (then called Los Rodeos - TCI ) , is situated in the northern part of Tenerife, and is now used mainly for flights within the Canary Islands and flights from the Spanish mainland

**Tenerife disaster**

Pan Am 1736 ablaze after its collision with KLM 4805

| Summary | |
|---|---|
| **Date** | March 27, 1977 |
| **Type** | Runway collision |
| **Site** | Tenerife, Canary Islands, Spain |
| **Fatal Injuries** | 583 |
| **Serious Injuries** | 61 |
| **Aircraft 1** | |
| **Aircraft type** | Boeing 747-121 |
| **Operator** | Pan American World Airways |
| **Registration** | N736PA |
| **Ship name** | *Clipper Victor* |
| **Passengers** | 380 |
| **Crew** | 16 |
| **Survivors** | 61 |
| **Aircraft 2** | |
| **Aircraft type** | Boeing 747-206B |
| **Operator** | KLM Royal Dutch Airlines |
| **Registration** | PH-BUF |
| **Ship name** | *Rijn* (Rhine River) |
| **Passengers** | 234 |
| **Crew** | 14 |
| **Survivors** | 0 |

## Contents

# Terrorist bomb threat

Pan Am Flight 1736 had taken off from Los Angeles International Airport with an intermediate stop at New York's JFK International Airport. The aircraft was a Boeing 747-121, registration N736PA. KLM Flight 4805, a charter flight from the Netherlands, had taken off four hours before from Amsterdam Schiphol Airport. The destination of both planes was Las Palmas on Gran Canaria.

Upon contacting Gran Canaria International Airport, the Pan Am flight was told that the airport was temporarily closed due to a terrorist bomb attack by Canary Island separatists. A bomb had exploded in the airport concourse, injuring several people, and a threat of a second bomb had been received. Although the Pan Am crew indicated that they would prefer to circle until landing clearance was given, the plane was ordered to divert to Tenerife North Airport (Los Rodeos) on the nearby island of Tenerife, together with many other planes. The KLM aircraft was also given instructions to divert to Los Rodeos.

In all, at least five large aircraft were diverted to Los Rodeos, a regional airport that could not easily accommodate them. The airport consisted of one runway and one major taxiway parallel to it, as well as several small taxiways connecting them. The diverted aircraft were parked on the long taxiway, meaning that it could not be used for taxiing. Instead, departing aircraft would have to taxi along the runway to position themselves for takeoff.

# Chain of events leading to disaster

## Refueling

After the threat at Gran Canaria International Airport had been contained, authorities reopened the airport. The Pan Am aircraft was ready to depart, but the KLM plane and a refueling vehicle obstructed the way to the active runway. Captain van Zanten had decided to refuel at Los Rodeos instead of Las Palmas, apparently to save time. The refuelling was to take an estimated 35 minutes. [1]

## Taxiing and weather conditions

Following the tower's instructions, the KLM aircraft was cleared to taxi to the end of the only runway and make a 180 degree turn (in aviation terms this is called a 'backtaxi', or 'backtrack', and is difficult with a 747 on the narrow runway). While KLM 4805 was backtaxiing on the runway, the controller asked the flight crew to report when it was ready to copy the ATC clearance. Because the flight crew was performing the checklist, copying this clearance was postponed until the aircraft was lined up in the direction of takeoff on Runway 30. During taxiing, the weather deteriorated. Fog had limited the visual range to 1000 feet (300 meters).

Pan Am was instructed to taxi along the same runway and take the third exit on their left, leaving the main runway, and head to the parallel taxiway. As the exits were not visually numbered or marked and the Pan Am airport chart did not designate the exits by number,[2] there was a degree of confusion in the Pan Am cockpit as to whether the control tower meant exit C3 or literally *the third exit on their left*,[3] as when this instruction had been received, the 747 was already past exit C1. Upon viewing their airport maps, the crew realized that leaving the runway at exit C3 would mean a 135° left turn onto the exit, and a 135° right turn onto the taxiway (for a simplified map of the runway and exits see Collision).

Since this maneuver is a difficult task for a 747 on an undersized airport, analysis of the cockpit voice recorder (CVR) recording suggests that the crew assumed that Tenerife ATC must have ordered them to turn at the next exit, C4, which was only 45°.

## Communication problems

Immediately after lining up, the KLM captain powered up the 747 to take off; however, the co-pilot advised the captain that ATC clearance had not been given and takeoff was aborted instantly. The KLM crew then received an ATC airways clearance; a clearance to fly a certain route after take-off, but not permission for the take-off itself. The captain may have mistaken this for a take-off clearance. He released the brakes of the aircraft and the co-pilot responded with a heavy Dutch accent with words that could either be "We are at take off" or "We are taking off".[2] The control tower was confused by the message and asked for the KLM plane to stand by. However, simultaneous communication from Pan Am caused mutual interference. All that was audible was a *heterodyne* beat tone, making the tower response inaudible to the pilots. Coincidentally, Pan Am was reporting they had not finished taxiing. Either message, if broadcast separately, would have given the KLM crew time to abort its takeoff.

Due to the fog, the KLM crew was not able to see the Pan Am 747 taxiing on the runway ahead of them. In addition, neither of the aircraft could be seen from the control tower, and the airport was not equipped with ground radar.

While the KLM crew had started its take-off run, the tower instructed the Pan Am crew to "report when runway clear". The crew replied: "OK, we'll report when we're clear". On hearing this, the KLM flight engineer expressed his concern about the Pan Am not being clear of the runway, repeating this concern a few seconds later, but he was overruled by the captain. The flight engineer did not explicitly challenge him on this decision.

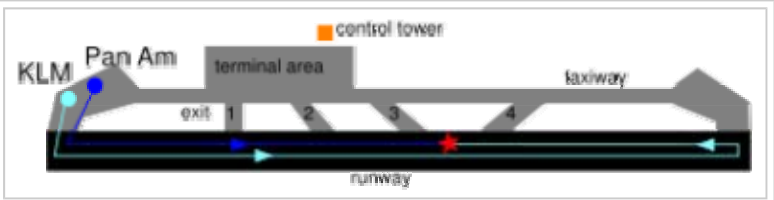
## Final radio transmissions

This section of the radio transmission is taken exactly from the original CVR transcript.

> **KLM (Radio)** Uh, the KLM ... four eight zero five is now ready for take-off ... uh and we're waiting for our ATC clearance.
> 1705:53.4
> **TENERIFE TOWERKLM** eight seven * zero five uh you are cleared to the Papa Beacon climb to and maintain flight level nine zero right turn after take-off proceed with heading zero four zero until intercepting the three two five radial from Las Palmas VOR.
> 1706:08.2 - 1706:09.6
> **KLM (Radio)** Ah roger, sir, we're cleared to the Papa Beacon flight level nine zero, right turn out zero four zero until intercepting the three two five and we're now (at take-off / uh..taking off).
> 1706:17.9 - 1706:13.0
> **KLM CAPTAIN** We gaan. (We're going)
> 1706:18.19
> **TENERIFE TOWER** OK.
> 1706:19.3
> **PanAm Radio(c/p)** No .. eh.
> 1706:20.08
> **TENERIFE TOWER** Stand by for take-off, I will call you.
> 1706:20.3
> **Pan Am Radio** (c/p) And we're still taxiing down the runway, the clipper one seven three six.
> 1706:19.39 - 1706:23.19

RDO and TENERIFE TOWER communications caused a shrill noise in KLM cockpit — messages not heard by KLM crew.
1706:25.6
**TENERIFE TOWER** Roger alpha one seven three six report when runway clear.
1706:29.6
**Pan Am Radio** (c/p) OK, we'll report when we're clear.
**TENERIFE TOWER** Thank you
1706:32.43
**KLM FLT ENGR** Is hij er niet af dan? {Is he not clear then?}
1706:34.1
**KLM CAPTAIN** Wat zeg je? {What do you say?}
1706:34.15
**KLM-?** Yup.
1706:34.7
**KLM FLT ENGR** Is hij er niet af, die Pan Am? {Is he not clear that Pan Am?}
1706:35.7
**KLM CAPTAIN** Jawel. {Oh yes. - emphatic}
1706:40.0
**KLM CAPTAIN** There he is.
Pan Am captain sees landing lights of KLM Boeing at approx. 700 m
**PAN AM CAPTAIN** He's coming straight ahead to us.
1706:44.0
PH-BUF started rotation

## Collision



Simplified map of runway, taxiways, and aircraft. The red star is the location of impact.

According to the CVR, Captain Grubbs, captain of the Pan Am plane, spotted the KLM's landing lights just as the plane approached exit C4. The Pan Am crew applied full power and took a sharp left turn onto the exit to avoid a collision. The KLM plane attempted to avoid a collision by climbing away, scraping the tail of the plane along the runway for 20 metres (65 ft). The lower fuselage of the KLM plane hit the upper fuselage of the Pan Am plane, ripping apart the center of the Pan Am jet nearly directly above the wing. The KLM plane then slammed into the ground belly-up 150 m past the point of collision and slid down the runway.

All 234 passengers and 14 crew members in the KLM plane were killed, and 326 passengers and 9 crew members aboard the Pan Am flight perished, primarily due to the fire and explosions resulting from the fuel spilled in the impact. Fifty-six passengers and 5 crewmembers aboard the Pan Am aircraft survived, including the Captain, First Officer, and Flight Engineer. Most of the survivors on the Pan Am aircraft were able to walk out onto the left wing through holes in the fuselage structure. At least one passenger stated that the 747's engines were still running for a few minutes after the accident. Survivors waited for rescue, but it didn't come promptly as the firefighters were initially unaware that there were two aircraft involved and were concentrating on the KLM wreck some distance away in the thick fog. Eventually, most of the survivors on the wings jumped to the ground below. The only member of the KLM passenger manifest to avoid the disaster was Robina van Lanschot, a travel guide who lived on Tenerife and elected not to reboard the 747 when it was due to

depart.[1]

# Investigation

A computer generated image of the impact

About 70 crash investigators from Spain, the Netherlands, the United States, and the two airline companies were involved in the investigation. Facts showed that there had been misinterpretations and false assumptions. Analysis of the CVR transcript showed that the KLM pilot was convinced that he had been cleared for take-off, while the Tenerife control tower was certain that the KLM 747 was stationary at the end of the runway and awaiting takeoff clearance.

## Probable cause

While there is disagreement about their relative importance, the investigation concluded that the major causal factors of the accident were:

- KLM mistakenly took off without a take-off clearance.
- The KLM captain did not interrupt take-off when the Pan Am crew reported that they were still on the runway.
- The KLM captain's emphatic affirmative in reply to the KLM flight engineer's query as to whether the Pan Am plane had already left the runway.
- Squelched radio messages (two calls between the planes and the control tower interfered with each other because they happened at precisely the same instant).
- Pan Am mistakenly continued to exit 4 instead of exiting at number 3 as directed by ATC.
- Use of ambiguous non-standard phrases by the KLM co-pilot ("We're at take off") and the Tenerife control tower ("O.K.").
- The airport, designed to handle smaller aircraft like the Boeing 737, was (due to rerouting from the bomb threat) forced to accommodate a large number of larger aircraft, resulting in disruption of the normal use of taxiways.

## Speculations

Experts speculated about other contributing factors:

- Captain van Zanten's failure to confirm instructions from the tower. The flight was one of his first after spending six months training new pilots on a flight simulator. He may have suffered from 'training syndrome', having been in charge of everything at the simulator (including simulated ATC), and having been away from the real world of flying for extended periods.[1]
- The flight engineer's apparent hesitation to further challenge van Zanten, possibly because van Zanten was not only senior in rank, but also one of the most able and experienced pilots working for the airline.[1]
- The possibility that van Zanten was in a hurry to commence the delayed flight due to Dutch regulations on exceeding crew duty hours.[4]
- The use of an unsafe procedure. An Air Traffic Control clearance by a control tower issued under no-visibility conditions is not a safe procedure as such a clearance is based on visual contact. However, most authorities allow control to continue based entirely on reports from pilots, who do not have visual contact either. Although this practice still occurs in some countries, it is increasingly being abandoned and superseded by the installation of surface movement radar. It has also been revealed that some countries do not conform entirely with

> international standards concerning poor visibility conditions. Some tower units accept it under the strict condition that only one aircraft is operating on the runway, while taxiing to and from it is done by using a vehicle called a "follow-me car" moving slowly ahead of the plane, leading the pilot. (The unsafe nature of the procedure that caused the accident in Tenerife was verified in a bitter way some 25 years later in what became known as the Linate Airport disaster at Milano Linate International Airport on October 8, 2001, when Flight SAS686, an MD-87 airliner, was cleared for take-off based on the report of a private jet plane (a German Cessna Citation) pilot that erroneously followed a different taxiway under zero visibility conditions, which did not allow a visual verification by the tower. The MD-87 collided with the Cessna that was crossing the runway and came down on aerodrome buildings, resulting in the deaths of 118 people.)[5]

There was some disagreement between the various investigative bodies, with the Dutch investigators accusing the Spaniards of listening to a soccer game and accusing the Americans of being at fault for staying on the runway. However, both the Spanish and American investigations pointed the finger mostly at the KLM crew.[4]

## Safety response

As a consequence of the accident, there were sweeping changes made to international airline regulations and to aircraft. Aviation authorities around the world introduced requirements for standard phrases and a greater emphasis on English as a common working language. For example, ICAO calls for the phrase "line up and wait" as an instruction to an aircraft moving into position but not cleared for take-off. The FAA equivalent is "taxi into position and hold". Air traffic instruction should not be acknowledged solely with a colloquial phrase such as "OK" or even "Roger", but with a read back of the key parts of the instruction, to show mutual understanding. Additionally the phrase "take-off" is only spoken when the actual take-off clearance is given. Up until that point both aircrew and ATCOs should use the phrase "departure" in its place (e.g. "ready for departure").

Cockpit procedures were also changed. Hierarchical relations among crewmembers were played down. More emphasis was placed on decision-making by mutual agreement. This is known in the industry as crew resource management, and is now standard training in all major airlines.

A second airport was inaugurated in 1978 on the South of the Island: the new Tenerife South Airport (TFS), This airport serves the majority of tourist flights esp. from britain.Then the renamed Tenerife North airport was used only for domestic and local flights ,but in the early part of the 21st c it has a new terminal and carries international traffic once again,inc budget airlines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Iceland

The Spanish authorities have installed a ground radar at Tenerife North following the accident. Dedicated to regional flights following the accident.

## Memorials

A memorial and final resting place for the victims of the KLM plane is located in Amsterdam, at *Westgaarde* cemetery. There is also a memorial in Westminster, California.

A memorial was dedicated at Tenerife North

*Canarian Weekly* memorial picture & story[1]

airport (TFN) on March 27, 2007. The 30th anniversary marks the first time that Dutch and American next of kin have joined in a ceremony.

# Miscellaneous

- Captain van Zanten was the preferred pilot for KLM publicity, such as magazine ads.
- Van Zanten had given the first officer on the accident flight, Klaas Meurs, his B747 qualification check about 2 months before the accident at Tenerife.
- Clipper Victor (ex-Clipper Mayflower and Clipper Young America), N736PA, was the first jumbo to carry fare-paying passengers, replacing the original Clipper Young America, N733PA, at the last minute due to the latter's engine problems, on Pan Am's maiden 747 passenger flight from New York to London on January 22, 1970.[1]

Captain Jacob van Zanten in KLM magazine ad

Well-known people who were killed in the disaster were:

- Eve Meyer, a pin-up model, film actress and producer and former wife of Russ Meyer.
- A. P. Hamann, the former city manager of San Jose, California, and his wife Frances Hamann.

# See also

- List of accidents and incidents on commercial airliners grouped by year
- Air Crash Investigation
- The 2005 Logan Airport runway incursion, where there was almost a similar disaster

# Notes

1. ^ **a b c d e** Macarthur Job (1995). *Air Disaster Volume 1*: pp.165-180
2. ^ **a b** Air Line Pilot, August 2000, p.18.
3. ^ NOVA:The Deadliest Plane Crash - The Final Eight Minutes. PBS. Retrieved on 2006 October 19.
4. ^ **a b** Nicholas Faith (1996, 1998). *Black Box*: pp.176-178
5. ^ Aviation Safety Network (SAS 686). Flight Safety Foundation. Retrieved on 2006 November 13.

# References

- Report from Pan Am site
- Coverage from Air Safety Network site (Pan Am 1736)
- Coverage from Air Safety Network site (KLM 4805)
- AirDisaster.com Accident Database (Pan Am 1736)
- AirDisaster.com Accident Database (KLM 4805)
- ICAO document mentioning phrasing used in the accident
- Air Line Pilot, August 2000, page 18

# External links

- ASN Pan Am N736PA Accident Description
- ASN KLM PH-BUF Accident Description
- BBC report with news report
- ICAO document mentioning phrasing used in the accident
- Comprehensive account of collision
- 1001 Crash - A complete story of the Tenerife disaster : This story includes DFDR transcriptions, and pictures taken the day of the tragedy
- Airmanship Online - a detailed account of the tragedy
- NOVA "The Deadliest Plane Crash" - Homepage to the NOVA TV episode
- Tenerife Memorial
- Project Tenerife
- PlaneCrashInfo.Com - Tenerife Disaster
- Ask the Pilot on the Tenerife disaster Patrick Smith, Salon.com

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