Hindenburg disaster

Coordinates: 40.030392°N 74.325745°W

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The ***Hindenburg* disaster** took place on Thursday, May 6, 1937, as the German passenger airship LZ 129 *Hindenburg* caught fire and was destroyed during its attempt to dock with its mooring mast at the Lakehurst Naval Air Station, which is located adjacent to the borough of Lakehurst, New Jersey. Of the 97 souls on board[N 1] (36 passengers, 61 crew), there were 35 fatalities as well as one death among the ground crew.

The disaster was the subject of spectacular newsreel coverage, photographs, and Herbert Morrison's recorded radio eyewitness report from the landing field, which was broadcast the next day. The actual cause of the fire remains unknown, although a variety of hypotheses have been put forward for both the cause of ignition and the initial fuel for the ensuing fire. The incident shattered public confidence in the giant, passenger-carrying rigid airship and marked the end of the airship era.[1]

LZ 129 Hindenburg

Hindenburg begins to fall seconds after catching fire.

Occurrence summary	
Date	May 6, 1937
Type	Airship fire
Site	Lakehurst Naval Air Station in Manchester Township, New Jersey, United States
Passengers	36
Crew	61
Injuries	N/A
Fatalities	36 (13 passengers, 22 crew, 1 ground crew)
Survivors	62
Aircraft type	*Hindenburg*-class airship
Aircraft name	*Hindenburg*
Operator	Deutsche Zeppelin-Reederei
Tail number	D-LZ129
Flight origin	Frankfurt am Main, Germany
Destination	Lakehurst Naval Air Station in Manchester Township, New Jersey, United States

Contents

Flight

After opening its 1937 season by completing a single round trip passage to Rio de Janeiro in late March, the *Hindenburg* departed from Frankfurt on the evening of May 3rd on the first of its 10 round trips between Europe and the United States scheduled for its second year of commercial service. The United States, American Airlines, which had contracted with the operators of the Hindenburg, was prepared to shuttle fliers from Lakehurst to Newark for connections to airplane flights.[2]

Post card carried on the D-LZ129

Except for strong headwinds which slowed its passage, the

"*Hindenburg*" on its last flight and dropped enroute over Cologne (*The Cooper Collections*)

Hindenburg's crossing was otherwise unremarkable until the airship's attempted early evening landing at Lakehurst three days later on May 6. Although carrying only half its full capacity of passengers (36 of 70) and 61 crew members (including 21 training crew members), the *Hindenburg's* return flight was fully booked with many of those passengers planning to attend the festivities for the coronation of King George VI in London the following week.

The airship was hours behind schedule when it passed over Boston on the morning of 6 May, and its landing at Lakehurst was expected to be further delayed because of afternoon thunderstorms. Advised of the poor weather conditions at Lakehurst, Captain Max Pruss charted a course over Manhattan, causing a public spectacle as people rushed out into the street to catch sight of the airship. After passing over the field at 4 p.m., Captain Pruss took passengers on a tour over the seasides of New Jersey while waiting for the weather to clear. After finally being notified at 6:22 p.m. that the storms had passed, the airship headed back to Lakehurst to make its landing almost half a day late. However, as this would leave much less time than anticipated to service and prepare the airship for its scheduled departure back to Europe, the public was informed that they would not be permitted at the mooring location or be able to visit aboard the *Hindenburg* during its stay in port.

Landing timeline

Around 7:00 p.m. local daylight saving time, at an altitude of 650 feet (200 m), the *Hindenburg* approached the Lakehurst Naval Air Station. This was to be a high landing, known as a *flying moor*, because the airship would drop its landing ropes and mooring cable at a high altitude, and then be winched down to the mooring mast. This type of landing maneuver would reduce the number of ground crew, but would require more time.

7:09: The airship made a sharp full speed left turn to the west around the landing field because the ground crew was not ready.

7:11: The airship turned back toward the landing field and valved gas. All engines idled ahead and the airship began to slow.

7:14: At altitude 394 feet (120 m), Captain Pruss ordered all engines full astern to try to brake the airship.

7:17: The wind shifted direction to southwest, and Captain Pruss was forced to make a second, sweeping sharp turn, this time towards starboard.

7:18: The airship made another sharp turn and dropped 300, 300 and 500 kg of water ballast in successive drops because the airship was stern heavy. Six men (three of whom were killed in the accident)[N 2] were also sent to the bow to trim the airship. These methods worked and the airship was on even keel as it stopped.

7:21: At altitude 295 feet (90 m), the mooring lines were dropped from the bow, the starboard line being dropped first, followed by the port line. The port line was overtightened as it was connected to the post of the ground winch; the starboard line had still not been connected.

First hints of disaster

At 7:25pm, a few witnesses saw the fabric ahead of the upper fin flutter as if gas were leaking.[3] Witnesses also reported seeing blue discharges—possibly static electricity—moments before the fire on top and in the back of the ship near the point where the flames first appeared.[4] Several other eyewitness testimonies suggest that the first flame appeared on the port side just ahead of the port fin, and was followed by flames which burned on top. Commander Rosendahl testified to the flames being "mushroom-shaped" and knew at once that the airship was doomed. One witness on the starboard side reported a fire beginning lower and behind the rudder on that side. On board, people heard a muffled explosion and those in the front of the ship felt a shock as the port trail rope overtightened; the officers in the control car initially thought the shock was due to a broken rope.

Disaster

At 7:25 p.m. local time, the *Hindenburg* caught fire and quickly became engulfed in flames.[3] Where the fire started is unknown; several witnesses on the port side saw yellow-red flames first jump forward of the top fin, around the vent of cell 4.[3] Other witnesses on the port side noted the fire actually began just ahead of the horizontal port fin, only then followed by flames in front of the upper fin. One, with views of the starboard side, saw flames beginning lower and farther aft, near cell 1. No. 2 Helmsman Helmut Lau also testified seeing the flames spreading from cell 4 into starboard. Although there were five newsreel cameramen and at least one spectator known to be filming the landing, no camera was rolling when the fire started and therefore there is no motion picture record of where it first broke out at the instant of ignition.

Wherever it started, the flames quickly spread forward. Instantly, a water tank and a fuel tank burst out of the hull due to the shock of the blast. This shock also caused a crack behind the passenger decks, and the rear of the structure imploded. The buoyancy was lost on the stern of the ship, and the bow lurched upwards as the falling stern stayed in trim.

A rare surviving fire-damaged 9" duralumin cross brace from the frame of the "Hindenburg" salvaged in May 1937 from the crash site at NAS Lakehurst, NJ. *(The Cooper Collections)*

As the *Hindenburg*'s tail crashed into the ground, a burst of flame came out of the nose, killing nine of the 12 crew members in the bow. There was still gas in the bow section of the ship, so the bow continued to point upward as the stern collapsed down. The crack behind the passenger decks collapsed inward, causing the gas cell to explode. The scarlet lettering "Hindenburg" became erased by flames while the airship's bow lowered. The airship's gondola wheel touched the ground, causing the bow to bounce up slightly as one final gas cell burned away. At this point, most of the fabric on the hull had also burned away and the bow finally crashed to the ground. Although the hydrogen had finished burning, the Hindenburg's diesel fuel burned for several more hours.

The time it took for the airship to be completely destroyed has been disputed. Some observers believe it took 34 seconds, others say it took 32 or 37 seconds. Since none of the newsreel cameras were filming the airship when the fire started, the time of the start of the fire can only be estimated from various eyewitness accounts, and will never be known accurately. One careful analysis of the flame spread, by Addison Bain of NASA, gives the flame front spread rate across the fabric skin as about 49 ft/s (15 m/s), which would have resulted in a total destruction time of about 16 seconds (245 m / 15 m/s = 16.3 s). Some of the duralumin framework of the airship was salvaged and shipped back to Germany where it was recycled and used in the construction of military aircraft for the Luftwaffe as were the frames of the *LZ 127 Graf Zeppelin* and *LZ 130 Graf Zeppelin II* as well when both were scrapped in 1940.[5]

Historic newsreel coverage

Main article: Hindenburg Disaster Newsreel Footage

Universal Newsreel

The disaster is well recorded because of the significant extent of newsreel coverage and photographs, as well as Herbert Morrison's live coverage on-the-scene, eyewitness radio report being made from the landing field for station WLS in Chicago which was broadcast the next day. Heavy publicity about the first transatlantic passenger flight of the year by Zeppelin to the U.S. attracted a large number of journalists to the landing. (The airship had already made one round trip from Germany to Brazil that year.) Parts of the Morrison report were later dubbed onto the newsreel footage and this gave the impression to many modern viewers, more accustomed to live television reporting, that the words and film were recorded together intentionally. Morrison's broadcast remains one of the most famous in history. His plaintive words, "Oh, the humanity!" resonate with the impact of the disaster, and have been widely used in popular culture. Part of the poignancy of Morrison's commentary is due to its being recorded at a slightly slower speed to the disk, so when played back at normal speed it seems to be at a faster delivery and higher pitch. When corrected, his account is less frantic sounding, though still impassioned.

> It's practically standing still now they've dropped ropes out of the nose of the ship; and (uh) they've been taken ahold of down on the field by a number of men. It's starting to rain again; it's... the rain had (uh) slacked up a little bit. The back motors of the ship are just holding it (uh) just enough to keep it from...**It's burst into flames!** It's burst into flames and it's falling it's crashing! Watch it; watch it! Get out of the way; Get out of the way! Get this, Charlie; get this, Charlie! It's fire... and it's crashing! It's crashing terrible! **Oh, my! Get out of the way, please!** It's burning and bursting into flames and the... and it's falling on the mooring mast. And all the folks agree that this is terrible; this is the one of the worst catastrophes in the world. [indecipherable] its flames... Crashing, oh! Four- or five-hundred feet into the sky and it... it's a terrific crash, ladies and gentlemen. It's smoke, and it's in flames now; and the frame is crashing to the ground, not quite to the mooring mast. **Oh, the humanity!** And all the passengers screaming around here. I told you; it—I can't even talk to people, their friends are out there! Ah! It's... it... it's a... ah! I... I can't talk, ladies and gentlemen. Honest: it's just laying there, mass of smoking wreckage. Ah! And everybody can hardly breathe and talk and the screaming. Lady, I... I... I'm sorry. Honest: I... I can hardly breathe. I... I'm going to step inside, where I cannot see it. Charlie, that's terrible. Ah, ah... I can't. Listen, folks; I... I'm gonna have to stop for a minute because [indecipherable] I've lost my voice. This is the worst thing I've ever witnessed.

— Herbert Morrison, describing the events, as transcribed for broadcast by WLS radio.

Spectacular motion picture footage and Morrison's passionate recording of the *Hindenburg* fire shattered public and industry faith in airships and marked the end of the giant passenger-carrying airships. Also contributing to the Zeppelins' downfall was the arrival of international passenger air travel and Pan American Airlines.[N 3] Aircraft regularly crossed the Atlantic and Pacific oceans much faster than the 130 km/h (80 mi/h) of the Hindenburg. The one advantage that the *Hindenburg* had over aircraft was the comfort it afforded its passengers, much like that of an ocean liner.

There had been a series of other airship accidents, none of them Zeppelins, prior to the *Hindenburg* fire. Many were caused by bad weather, and most of these accidents were dirigibles of British or U.S. manufacture. Zeppelins had an impeccable safety record. The *Graf Zeppelin* had flown safely for more than 1.6 million km (1 million miles), including the first circumnavigation of the globe by an airship. The Zeppelin company's promotions prominently featured the fact that no passenger had been injured on one of their airships.

Death toll

See also: List of passengers and crew aboard the final flight of LZ 129 Hindenburg

Despite the violent fire, many of the crew and passengers survived. Of the 36 passengers and 61 crew, 13 passengers and 22 crew died. Also killed was one member of the ground crew, civilian linesman Allen Hagaman. The majority of the crew who died were up inside the ship's hull, where they either did not have a clear escape route or else were close to the bow of the ship, which hung burning in the air too long for most of them to escape the fire. Most of the passengers who died were trapped in the starboard side of the passenger deck. Not only was the wind blowing the fire toward the starboard side, but the ship also rolled slightly to starboard as it settled to the ground, with much of the upper hull on that part of the ship collapsing outboard of the starboard observation windows, thus cutting off the escape of many of the passengers on that side.[N 4] To make matters worse, the sliding door leading from the starboard passenger area to the central foyer and the gangway stairs (through which rescuers led a number of passengers to safety) jammed shut during the crash, further trapping those passengers on the starboard side.[N 5] Nonetheless, some did manage to escape from the starboard passenger decks. A number of others did not. By contrast, all but a few of the passengers on the port side of the ship survived the fire, with some of them escaping virtually unscathed. Although the most famous of airship disasters, it was not the worst. Just over twice as many perished (73 of 76 on board) when the helium-filled U.S. Navy scout airship *USS Akron* crashed at sea off the New Jersey coast four years earlier on April 4, 1933.

Some of the survivors were saved by luck. Werner Franz, the 14 year-old cabin boy, was initially dazed by the realization that the ship was on fire. As he stood near the officer's mess where he had been putting away dishes moments before, a water tank above him burst open, and he was suddenly soaked to the skin. Not only did this snap him back to his senses, as he later told interviewers, but it also put out the fire around him. He then made his way to a nearby hatch through which the kitchen had been provisioned before the flight, and dropped through it just as the forward part of the ship was briefly rebounding into the air. He began to run toward the starboard side, but stopped and turned around and ran the other way, because the flames were being pushed by the wind in that same direction. He made it clear of the wreck with little more than singed eyebrows and soaking wet clothes. Werner Franz is one of the two people aboard who are still alive as of 2008.[*citation needed*]

When the control car crashed on the ground, most of the officers had leapt through the windows, but became separated. First Officer Captain Albert Sammt found Captain Max Pruss trying to re-enter the wreckage to look for survivors. Pruss's face was badly burned, and he required months of hospitalization and reconstructive surgery, but he survived.

Captain Ernst Lehmann escaped the crash with burns to his head and arms and severe burns across most of his back. Though his burns did not seem quite as severe as those of Pruss, he died at a nearby hospital the next day.

When passenger Joseph Späh, a vaudeville comic acrobat, saw the first sign of trouble he smashed the window with his movie camera, with which he had been filming the landing (the film survived the disaster). As the ship neared the ground he lowered himself out the window and hung onto the window ledge, letting go when the ship was perhaps 20 feet above the ground. His acrobat's instincts kicked in, and Späh kept his feet under him and attempted to do a safety roll when he landed. He injured his ankle nonetheless, and was dazedly crawling away when a member of the ground crew came up, slung the diminutive Späh under one arm, and ran him clear of the fire.[N 6] [N 7]

Of the 12 crewmen in the bow of the airship, only three survived. Four of these 12 men were standing on the mooring shelf, a platform up at the very tip of the bow from which the forward-most landing ropes and the steel mooring cable were released to the ground crew, and which was directly at the forward end of the axial walkway and just ahead of gas cell #16. The rest were standing either along the lower keel walkway ahead of the control car, or else on platforms beside the stairway leading up the curve of the bow to the mooring shelf. During the fire the bow hung in the air at roughly a 45-degree angle and flames shot forward through the axial walkway, bursting through the bow (and the bow gas cells) like a blowtorch. The three men from the forward section who survived (elevatorman Kurt Bauer, cook Alfred Grözinger, and electrician Josef Leibrecht) were those furthest aft of the bow, and two of them (Bauer and Grözinger) happened to be standing near two large triangular air vents, through which cool air was being drawn by the fire. Neither of these men sustained more than superficial burns.[N 8] Most of the men standing along the bow stairway either fell aft into the fire, or tried to leap from the ship when it was still too high in the air. Three of the four men standing on the mooring shelf inside the very tip of the bow were actually taken from the wreck alive, though one (Erich Spehl, a rigger) died shortly afterward in the Air Station's infirmary, and the other two (helmsman Alfred Bernhard and apprentice elevatorman Ludwig Felber) were reported by newspapers to have initially survived the fire, and then to subsequently have died at area hospitals during the night or early the following morning.

The four crew members in the tail fin all survived; they were closest to the origin of the fire but sheltered by the structure of the lower fin. They escaped by climbing out the fin's access hatch when the tail hit the ground.

Hydrogen fires are notable for being less destructive to immediate surroundings than gasoline explosions because of the buoyancy of H_2, which causes heat of combustion to be released upwards more than circumferentially as the leaked mass ascends in the atmosphere; hydrogen fires are more survivable than fires of gasoline and of wood.[7] The hydrogen in the Hindenburg burned out within about 90 seconds.

Cause of ignition

Sabotage theory

At the time of the disaster, sabotage was commonly put forward as the cause of the fire, initially by Hugo Eckener, former head of the Zeppelin Company and the "old man" of German airships. Eckener later publicly endorsed the static spark theory. Eckener, who was at the time on a lecture tour in Austria, was awakened at about 2:30 in the morning (8:30 PM Lakehurst time, or approximately an hour after the crash) by the ringing of his bedside telephone. It was a Berlin representative of the *New York Times* with news that the *Hindenburg* "exploded yesterday evening at 7 p.m [*sic*] above the airfield at Lakehurst." By the time he left the hotel the next morning to travel to Berlin for a briefing on the disaster, the only answer that he had for the reporters waiting outside to question him was that based on what he knew, that the *Hindenburg* had "exploded over the airfield", sabotage might be a possibility. However, as he learned more about the disaster, particularly that the airship had burned rather than actually "exploding", he grew more and more convinced that static discharge, rather than sabotage, was the actual culprit.[8]

Commander Charles Rosendahl, commander of the Naval Air Station at Lakehurst and the man in overall charge of the ground-based portion of the *Hindenburg's* landing maneuver, also came to believe that the *Hindenburg* had been sabotaged. He laid out a general case for sabotage in his 1938 book *What About the Airship?*,[9] which was as much an extended argument for the further development of the rigid airship as it was an historical overview of the airship.

Another proponent of the sabotage hypothesis was Max Pruss, commander of the *Hindenburg* throughout the airship's career. Pruss flew on nearly every flight of the *Graf Zeppelin* until the Hindenburg was ready. In a 1960 interview conducted by Kenneth Leish for Columbia University's Oral History Research Office, Pruss said early dirigible travel was safe, and therefore he strongly believed that sabotage was to blame. He stated that on trips to South America, which was a popular destination for German tourists, both airships passed through thunderstorms and were struck by lightning but remained unharmed.[10]

The airship's crew refused to believe that one of them would commit an act of sabotage, insisting only a passenger could have destroyed the airship. A suspect favored by Commander Rosendahl, Captain Pruss, and others among the *Hindenburg's* crew, was passenger Joseph Späh, a German acrobat who survived the fire. He brought with him a dog, a German shepherd named Ulla, as a surprise for his children. (Ulla did not survive.) He reportedly made a number of unaccompanied visits to feed his dog, who was being kept in a freight room near the stern of the ship. Those who suspected Späh based their suspicions primarily on those trips into the ship's interior to feed his dog, that according to some of the stewards Späh had told anti-Nazi jokes during the flight, recollections by stewards that Späh had seemed agitated by the repeated delays in landing, and that he was an acrobat who could conceivably climb into the airship's rigging to plant a bomb.

In 1962, A. A. Hoehling published *Who Destroyed the Hindenburg?*, where he rejected all theories but sabotage, and named a crew member as the suspect. Eric Spehl, a rigger on the Hindenburg who died in the fire, was named as the saboteur. Ten years later, Michael MacDonald Mooney's book, *The Hindenburg*,

which was based heavily on Hoehling's sabotage theory, also identified Spehl as the saboteur; Mooney's book was made into the movie *The Hindenburg,* whose producers were sued by Hoehling for plagiarism, but Hoehling lost because he had presented his sabotage theory as historical fact, and one cannot claim ownership of historical facts.[11]

Hoehling claimed the following in naming Spehl as the culprit:

- Spehl's girlfriend had communist beliefs and anti-Nazi connections.
- The fire's origin was near the catwalk running through Gas Cell 4, which was an area of the ship generally off-limits to anyone other than Spehl and his fellow riggers.
- Rumors that the Gestapo had investigated Spehl's possible involvement in 1938.
- Spehl's interest in amateur photography, making him familiar with flashbulbs that could have served as an igniter.
- The discovery by representatives of the NYPD Bomb Squad of a substance that was later determined to likely be "the insoluble residue from the depolarizing element of a small, dry battery." (Hoehling postulated that a dry cell battery could have powered a flashbulb in an incendiary device.)
- The discovery by FBI Agents of a yellow substance on the valve cap of the airship between cells 4 and 5 where the fire was first reported. Some have suggested this to be sulfur, which can ignite hydrogen. (However, a further investigation into this suggested that the residue was actually from a fire extinguisher in the stern of the ship.)
- A flash or a bright reflection that crew members near the lower fin had seen just before the fire.

Hoehling's (and later Mooney's) theory goes on to say that it is unlikely that Spehl wanted to kill people, and that he intended for the airship to burn after the landing instead. However, with the ship already over 12 hours late, Spehl was in the end unable to find an excuse to reset the timer on his bomb.

During the landing maneuver, rigger Hans Freund dropped a landing line in front of the lower fin. The line became caught in the bracing wires of the airship, so No. 2 helmsman Helmut Lau climbed up from the lower fin to release it. According to Hoehling, Freund described a flash like a flashbulb's, and Lau said he saw a brilliant reflection between cells 4 and 5. They then heard a muffled detonation and a thud as the *Hindenburg's* back broke. Some believe that this is evidence for sabotage. Others believe Freund was actually looking rearward, away from cells 4 and 5, but that Rudolf Sauter, another crew member in the lower fin had seen the flash.[12]

Since the publication of Hoehling's book, most airship historians, including Dr. Douglas Robinson, have dismissed Hoehling's sabotage theory because no solid evidence was ever presented to support it. No pieces of a bomb were ever discovered (and in fact there is no evidence in existing documentation that the sample collected from the wreckage, and determined to be residue from a dry cell battery, was found anywhere near the stern of the airship), and on closer examination the evidence against Spehl and his girlfriend turned out to be largely circumstantial.

It has even been suggested that Adolf Hitler himself ordered the *Hindenburg* to be destroyed in retaliation for Eckener's anti-Nazi opinions.[13]

However, opponents of the sabotage hypothesis argued that only speculation supported sabotage as a cause of the fire, and no credible evidence of sabotage was produced at any of the formal hearings. Eric Spehl died in the fire and was therefore unable to refute the accusations that surfaced a quarter of a century later. The FBI investigated Joseph Späh and reported finding no evidence of Späh having any connection to a sabotage plot. According to his wife, Evelyn, Späh was quite upset over the accusations - she later recalled that her husband was outside their home cleaning windows when he first learned that he was suspected of sabotaging the *Hindenburg,* and was so shocked by the news that he almost fell off the ladder on which he was standing.[14]

Neither the German nor the American investigation endorsed any of the sabotage theories. Proponents of the sabotage theory argue that any finding of sabotage would have been an embarrassment for the Nazi regime, and they speculate that such a finding by the German investigation was suppressed for political reasons.

Eckener believed that the reason why Pruss, Lehmann, and Rosendahl supported sabotage was because they may have felt guilty for their acts. Pruss made the sharp turn, Lehmann pressured Pruss to make it, and Rosendahl called the airship in.[15]

Static spark theory

Hugo Eckener argued that the fire was started by an electric spark caused by a buildup of static electricity on the airship.[16] The spark ignited hydrogen or the outer skin (see Incendiary paint theory below).

Proponents of the static spark theory point out that the airship's skin was not constructed in a way that allowed its charge to be distributed evenly throughout the craft. The skin was separated from the duralumin frame by non conductive ramie cords which had been lightly covered in metal to improve conductivity,

however not very effectively, allowing a large difference in potential to form between them.

In order to make up for the delay of more than 12 hours in its transatlantic flight, the *Hindenburg* passed through a weather front of high humidity and high electrical charge. The storm could have made the airship's mooring lines wet and thus conductive, and may also have built up an electrical charge in its skin. The mooring lines also could have gotten wet as a light rain continued to fall at Lakehurst.

When the mooring lines, which were connected to the frame, touched the earth they would have grounded the frame but not the skin. This would have caused a sudden potential difference between skin and frame (and the airship itself with the overlying air masses) and would have set off an electrical discharge — a spark. Seeking the quickest way to the ground the spark would have jumped from the skin onto the metal framework, igniting the leaking hydrogen.

In his 1964 book, *LZ-129 Hindenburg,* Zeppelin historian Dr. Douglas Robinson points out that although ignition of free hydrogen by static discharge had become a favored theory, no such discharge was seen by any of the witnesses who testified at the official investigation into the accident back in 1937. He goes on to write:

> But within the past year, I have located an observer, Professor Mark Heald of Princeton, New Jersey, who undoubtedly saw St. Elmo's Fire flickering along the airship's back a good minute before the fire broke out. Standing outside the main gate to the Naval Air Station, he watched, together with his wife and son, as the Zeppelin approached the mast and dropped her bow lines. A minute thereafter, by Mr. Heald's estimation, he first noticed a dim "blue flame" flickering along the backbone girder about one-quarter the length abaft the bow to the tail. There was time for him to remark to his wife, "Oh, heavens, the thing is afire," for her to reply, "Where?" and for him to answer, "Up along the top ridge" - before there was a big burst of flaming hydrogen from a point he estimated to be about one-third the ship's length from the stern.[17]

Unlike other witnesses to the fire whose view of the port side of the ship had the light of the setting sun behind the ship, Professor Heald's view of the starboard side of the ship against a backdrop of the darkening eastern sky would have made the dim blue light of a static discharge (or burning hydrogen) atop the ship more easily visible.

Harold G. Dick was Goodyear Zeppelin's representative with Luftschiffbau Zeppelin during the mid-1930s. He flew on test flights of the *Hindenburg* and its sister ship, the *Graf Zeppelin II*. He also flew on numerous flights in the original *Graf Zeppelin* and 10 round trip crossings of the north and south Atlantic in the *Hindenburg*. In his book *The Golden Age of the Great Passenger Airships Graf Zeppelin & Hindenburg*, he observes:

> There are two items not in common knowledge. When the outer cover of the LZ 130 [the *Graf Zeppelin II*] was to be applied, the lacing cord was prestretched and run through dope as before, but the dope for the LZ 130 contained graphite to make it conductive. This would hardly have been necessary if the static discharge theory were mere cover up. The use of graphite dope was not publicized and I doubt if its use was widely known at the Luftschiffbau Zeppelin.

In addition to Dick's observations is the fact that during the *Graf Zeppelin II's* early test flights, measurements were taken of the airship's static charge. It is clear that Dr. Ludwig Durr and the other engineers at Luftschiffbau Zeppelin took the static discharge theory seriously and considered the insulation of the fabric from the frame to be a design flaw in the *Hindenburg*. Thus, the German Inquiry concluded that the insulation of the outer covering caused a spark to jump onto a nearby piece of metal, therefore igniting the hydrogen. In lab experiments, using the *Hindenburg's* outer covering and a static ignition, hydrogen was able to be ignited, but with the covering of the LZ 127 *Graf Zeppelin,* nothing happened. These findings were not well-publicized and covered up, perhaps to avoid embarrassment of such an engineering flaw in the face of the Third Reich.

A variant of the static spark theory, presented by Addison Bain, is that a spark between inadequately grounded fabric cover segments of the *Hindenburg* itself started the fire, and that the spark had ignited the "highly flammable" outer skin. The *Hindenburg* had a cotton skin covered with a finish known as "dope". It is a common term for a plasticised lacquer that provides stiffness, protection, and a lightweight, airtight seal to woven fabrics. In its liquid forms, dope is highly flammable, but the flammability of dry dope depends upon its base constituents, with, for example, butyrate dope being far less flammable than cellulose nitrate. Proponents of this theory claim that when the mooring line touched the ground, a resulting spark could have ignited the dope in the skin.

Lightning theory

A. J. Dessler, former director of the Space Science Laboratory at NASA's Marshall Space Flight Center and a critic of the incendiary paint theory (see below), favors a much simpler explanation for the conflagration: lightning. Like many other aircraft, the *Hindenburg* had been struck by lightning several times. This does not normally ignite a fire in hydrogen-filled airships, because the hydrogen is not mixed

with oxygen. However, many fires started when lightning struck airships as they were venting hydrogen as ballast in preparation for landing, which the Hindenburg was doing at the time of the disaster. The vented hydrogen mixes with the air, making it readily combustible.

However, Dr. Eckener believed that the way the fire appeared was not consistent with that of a fire caused by lightning. Witnesses described the fire appearing in a wave motion. He also asserted that witnesses did not see any lightning storms during the airship's final approach.[15]

Engine failure theory

On the 70th anniversary of the accident, *The Philadelphia Inquirer* carried an article[18] with yet another theory, based on an interview of ground crew member Robert Buchanan. He had been a young man on the crew manning the mooring lines.

As the airship was approaching the mooring mast, he noted that one of the engines, thrown into reverse for a hard turn, backfired, and a shower of sparks was emitted. After being interviewed by Addison Bain, Buchanan believed that the airship's outer skin was ignited by engine sparks. Another ground crewman, Robert Shaw, saw blue ring behind the tail fin and had also seen sparks coming out of the engine.[19] Shaw believed that the blue ring he saw was leaking hydrogen which was ignited by the engine sparks.

Dr. Eckener rejected the idea that hydrogen could have been ignited by an engine backfire when that theory was mentioned at an unofficial inquiry, which was a chat with crew members. Dr. Eckener believed that the hydrogen could not have been ignited by any exhaust because the temperature is too low to ignite the hydrogen. The ignition temperature for hydrogen is 700 °C (1,292 °F), but the sparks from the exhaust only reach 250 °C (482 °F).[15] The Zeppelin Company also carried out extensive tests and hydrogen had never ignited. Additionally, the fire was first seen at the top of the airship, not near the bottom of the hull.

Fire's initial fuel

Most current analysis of the fire assumes ignition due to some form of electricity as the cause. However, there is still much controversy over whether the fabric skin of the airship, or rather the hydrogen used for buoyancy, was the initial fuel for the resulting fire.

Incendiary paint theory

The incendiary paint theory was proposed in 1996 by retired NASA scientist Addison Bain, stating that the doping compound of the airship was the cause of the fire. The theory is limited to the source of ignition and to the flame front propagation, not to the source of most of the burning material, as once the fire started and spread the hydrogen clearly must have burned (although proponents of the IPT claim that hydrogen burned much later in the fire). Instead, for this topic the incendiary paint theory asserts that the major component in starting the fire and feeding its spread was the canvas skin because of the compound used on it.

Proponents of this theory point out that the coatings on the fabric contained both iron oxide and aluminum-impregnated cellulose acetate butyrate (CAB). These components remain potentially reactive even after fully setting. In fact, iron oxide and aluminum can be used as components of solid rocket fuel or thermite. For example, the propellant for the Space Shuttle solid rocket booster includes both "aluminum (fuel, 16%), (and) iron oxide (a catalyst, 0.4%)". However, the coating applied to Hindenburg's covering did not have a sufficient quantity of any material capable of acting as an oxidizer,[20] which is a necessary component of rocket fuel.[21]

Bain received permission from the German government to search their archives and discovered evidence that, during the Nazi regime, German scientists concluded the dope on the *Hindenburg's* fabric skin was the cause of the conflagration. Bain interviewed the wife of the investigation's lead scientist, and she stated that her husband had told her about the conclusion and instructed her to tell no one, presumably because it would have embarrassed the Nazi government.[22]

In television shows, Bain tried to prove the flammability of the fabric by igniting it with an electrical machine; critics claim it was not possible for the fabric to have been ignited by a static spark. Although the fabric ignited, critics point out that Bain had to correctly position the fabric so it would be ignited, and he used a Jacob's Ladder with a continuous electric current inconsistent with atmospheric conditions. Additionally, the German scientists at the time concluded that it was the poor conductivity, not the flammability of the doping compound, that lead to the ignition of hydrogen.[12]

Critics point out that port side witnesses on the field, as well as crew members stationed in the stern, saw a glow inside Cell 4 before any fire broke out of the skin, indicating that the fire began inside the airship (or that it was a hydrogen fire feeding on the whole cell). Newsreel footage the fact that the fire was burning inside the structure.[14]

Proponents of the paint theory claim that the glow can be explained. They claim that what witnesses saw was the fire on the starboard side (another proponent claims that a witness saw the fire start from the starboard side) through the outer skin, looking like a glow. However, photographs of the early stages of the fire show the gas cells of the *Hindenburg's* entire aft section fully aflame. Burning gas spewing upward from the top of the airship was causing low pressure inside, allowing atmospheric pressure to press the skin inwards. It should also be noted that not all fabric on the Hindenburg burned.[23] The fabric on several of the tail structures was not completely consumed. That the fabric not near the hydrogen fire extinguished itself is not consistent with the "explosive" dope theory.

Occasionally the Hindenburg's varnish is incorrectly identified as, or stated being similar to, cellulose nitrate, which, like most nitrates burns very readily. Instead, the cellulose acetate butyrate (CAB) used to seal the zeppelin's skin is rated by the plastics industry as combustible but nonflammable. That is, it will burn if placed within a fire but is not readily ignited. In fact, it is considered self extinguishing without some kind of additional fuel. That many pieces of the Hindenburg's skin survived despite such a fierce fire is cited as proof.

While not issuing an opinion about whether it was the hydrogen or the treated skin of the airship that ignited first, the TV show *MythBusters* explored the incendiary paint theory. Their findings indicated that the aluminum/iron oxide ratios in the Hindenburg's skin, while certainly flammable, were not enough on their own to destroy the zeppelin. Had the skin in fact contained enough metal to produce pure thermite, the Hindenburg would have been too heavy to fly. And even if it somehow did, a pure thermite reaction (at ~ 2,500 °C (4,530 °F)) would have completely melted the airframe (assuming Aluminium 2024's melting point of ~630 °C (1,166 °F) for the duralumin of the day), whereas the real disaster left the spars and ribs recognizable. The MythBusters team also discovered that the Hindenburg's coated skin required a higher temperature to ignite than untreated material and would initially burn slowly, but after some time the fire would begin to accelerate considerably. From this they concluded that the proponents against the IPT may have been wrong about the airship's skin being inflammable due to being separated in different layers. The Mythbusters concluded that the paint may have contributed to the disaster, but that it was not the sole reason for such rapid combustion.[24]

Hydrogen theory

Offering support for the theory that there was some sort of hydrogen leak prior to the fire is that the airship remained stern-heavy before landing. This could have been caused by a massive leak of the gas, which started mixing with air and filling up the space between the skin and the cells.[15] Pictures that show the fire burning along straight lines that coincide with the boundaries of gas cells suggest that the fire was not burning along the skin, which was continuous. Crew members stationed in the stern reported actually seeing the cells burning.[25]

There are many theories about how that gas might have leaked, but the actual cause remains unknown. Many believe it was that a bracing wire cracked (see below), while others believe that a vent was stuck open and gas leaked through. During one trip to Rio, a gas cell was nearly emptied when a vent was stuck open, and gas had to be transferred from other cells to maintain an even keel.[14]

Although proponents of the IPT claim that the hydrogen was odorized with garlic, it would have been detectable only in the area of a leak. Once the fire was underway, more powerful smells would have masked any garlic odor. There were no reports of anyone smelling garlic during the flight, but no official documents have been found to prove that the hydrogen even was odorized.

Opponents of this theory note that the fire was reported as burning bright red, while pure hydrogen burns blue if it's visible at all,[26] although there were many other materials that were consumed by the fire which could have changed its hue.

Most of the airshipmen at the time, including Captain Pruss, believed that the stern heaviness was normal, since aerodynamic pressure would push rainwater towards the stern of the airship. However, reports of the amount of rain the ship had collected have been inconsistent. Several witnesses testified that there was no rain as the ship approached until a light rain fell minutes before the fire, while several crew members stated that before the approach the ship did encounter heavy rain.[27] The stern heaviness was also noticed minutes before the airship made its sharp turns for its approach, and crew members stated that it was corrected as the ship stopped (after sending six men into the bow section of the ship). Additionally, the gas cells of the ship were not pressurized, and a leak would not cause the fluttering of the outer cover, which wasn't seen until seconds before the fire.

Puncture theory

One hypothesis on how gas could have leaked is that one of the many bracing wires within the airship snapped and punctured at least one of the internal gas cells during one of the sharp turns in the landing maneuver. Advocates of this theory believe that the hydrogen began to leak approximately five minutes before the fire.[15] Newsreels as well as the account of the landing approach show the *Hindenburg* made several sharp turns, first towards port and then starboard, just before the accident. Gauges found in the

wreckage showed the tension of the wires was much too high, and some of the bracing wires may have even been substandard. One bracing wire tested after the crash broke at a mere 70% of its rated load.[14] A punctured cell would have freed hydrogen into the air and could have been ignited by a static discharge (see above), or it is also possible that the broken bracing wire struck a girder causing sparks to ignite hydrogen.[14]

A ground crew member, R.H. Ward, reported seeing a piece of the airship fluttering, "as if gas was rising and escaping" from the cell. He said that the fire began there, but that no other disturbance occurred at the time when the fabric fluttered.[15] Another man on the top of the mooring mast had also reported seeing a flutter in the fabric as well.[28] When the fire started, people on board the airship reported hearing a muffled sound, and another ground crew member on the starboard side reported hearing a crack. Some speculate the sound was from a bracing wire snapping.[14]

Dr. Eckener concluded that the puncture theory was the most likely explanation for the disaster. Because of this, he felt that Captains Pruss and Lehmann, and Charles Rosendahl were to blame for the rushing the landing procedure.[15] He believed that Lehmann told Pruss to make the sharp turn, and that Pruss and Rosendahl were concerned more about the time delay than the weather, because an unobserved storm front occurred just when the Hindenburg approached.[15] But Eckener knew that he was to blame as much as anyone else, for in 1928 he decided against using helium offered by the US government for economic reasons.[15]

Concluding the United States Inquiry on the disaster, Eckener testified that he believed that the fire was caused by the ignition of hydrogen by a static spark:

> I believe that the fire was not caused by an electrical spark, but by a static spark. A thunderstorm front had passed before the landing maneuver. However if one observes more closely one can see that this was followed by a smaller storm front. This created conditions suitable for static sparks to occur. I believe spark had ignited gas in the rear of the ship.
>
> It may seem strange that the fire did not occur the moment the landing ropes had touched the ground, because that is when the airship would have been earthed. I believe there is an explanation for this. When the ropes were first dropped they were very dry, and poor conductors. Slowly however they got dampened by the rain that was falling and the charge was slowly equalized. Thus the potential difference between the airship and the overlying air masses would have been sufficient enough to generate static electricity. The Hindenburg would have acted as a giant kite, close to the storm clouds, collecting a static spark.
>
> I am convinced that a leak must have occurred in the upper rear section of the ship. My assumption is confirmed by the remarkable observations by one of the witnesses. He described seeing a peculiar flutter as if gas were rising and escaping. If I were to be asked to explain what had caused this abnormal build-up of gas, I could only make to myself one explanation.
>
> The ship proceeded in a sharp turn during its landing maneuver. This would have generated extremely high tension in the sections close to the stabilizing fins, which are braced by shear wires. I suspect that under such tension one of these wires may have broken and caused a rip in one of the gas cells. The gas then filled up the space between the cell and the outer cover, which is why the airship sank at the rear. This accumulated amount of gas was then ignited by a static spark. This was not lightning but a small static spark, enough to ignite free gas in the rear.[15]

Other controversial hypotheses

Structural failure

Captain Pruss believed that the *Hindenburg* could withstand tight turns without significant damage. Other engineers and scientists believe that the airship would have been weakened by being repeatedly stressed.

The airship's landing approach proceeded in two sharp turns. The first turn was towards port at full speed as the airship circled the landing field. After it had circled the landing field, the wind shifted direction towards the southwest, and a sharper turn to starboard was ordered near the end of the landing maneuver. One or both of these turns in opposite directions could have weakened the structure.

However, evidence against this theory is the fact that the first sharp turn was too wide and circular to cause any damage, and that the final turn, while considered sharp, was far too slow for any structural failure to occur.

The airship did not receive much in the way of routine inspections even though there was evidence of at least some damage on previous flights. It is not known whether that damage was properly repaired or even whether all the failures had been found. The *Hindenburg* had once lost an engine and almost drifted over Africa, where it could have crashed. Afterwards, Dr. Eckener ordered section chiefs to inspect the airship

during flight.

In March 1936, the *Hindenburg* and the *Graf Zeppelin* made three-day flights to drop leaflets and broadcast speeches via loudspeaker. Before the airship's takeoff on March 26, 1936, Ernest Lehmann chose to launch the *Hindenburg* with the wind blowing from behind the airship, instead of into the wind as per standard procedure. During the takeoff, the airship's tail struck the ground, and part of the lower fin was broken.[29] Many spectators' cameras were confiscated to prevent negative publicity, but Harold G. Dick concealed his camera and took pictures of the damaged fin. Dr. Eckener was very upset and rebuked Captain Lehmann:

> How could you, Herr Lehmann, order the ship to be brought out in such wind conditions. You had the best excuse in the world for postponing this idiotic flight; instead, you risk the ship, merely to avoid annoying Herr Goebbels. Do you call this showing a sense of responsibility towards our enterprise?[12]

Though that damage was repaired, the force of the impact may have caused internal damage.

Only six days before the disaster, there was a plan assisted to make the *Hindenburg* have a hook on her hull to carry aircraft in a similar way to what the Navy did with the USS Akron and the USS Macon. However, the trials were unsuccessful; the biplane hit the Hindenburg's trapeze several times.

Photographs and newsreels of the initial stages of the fire show that the stern section of the airship collapsed inward in a similar way to an eggshell, as well as a "crack" directly behind the passenger decks. When the stern of the ship hit the ground and collapsed, this part collapsed inward, causing another plume of fire to start.

This theory has not been very popular because it is not so much about what caused the fire as an element of support for the puncture theory. However, the theory that a bracing wire snapped during the two sharp turns prior to landing would explain the theory about leaking hydrogen, which would provide a possible explanation as to how the fire began.

Fuel leak

The 2001 documentary *Hindenburg Disaster: Probable Cause* suggested that 16-year-old Bobby Rutan, who claimed that he had smelled "gasoline" when he was standing below the Hindenburg's aft port engine, had detected a diesel fuel leak. During the investigation, Commander Charles Rosendahl dismissed the boy's report. The day before the disaster, a fuel pump had broken during the flight. A crew member said this was fixed but it may not have been done properly. The resulting vapor would have been highly flammable and could have self combusted. The film also suggested that overheating engines may have played a role.

Critics say the documentary is misleading because it misconstrued the statements by the crewmen in the *Hindenburg's* lower fin. The crewmen said they saw a flash in the axial catwalk, but the film placed the flash in the keel catwalk closer to the passenger areas.

Luger pistol among wreckage

Some more sensational newspapers at the time said that a person on board committed suicide because a Luger pistol with one shell fired was found among the wreckage.[12][30] Yet, there is no such evidence suggesting an attempted suicide.

Rate of flame propagation

Fabric of the Hindenburg, held in the Steven F. Udvar-Hazy Center

Regardless of the source of ignition or the initial fuel for the fire, there remains the question of what caused the rapid spread of flames along the length of the airship. Here again the debate has centered on the fabric covering of the airship and the hydrogen used for buoyancy.

Proponents of both the incendiary paint theory and the hydrogen theory agree that the fabric coatings were probably responsible for the rapid spread of the fire. The combustion of hydrogen is not usually visible to the human eye in daylight, because most of its radiation is not in the visible portion of the spectrum but rather ultraviolet. Thus what can be seen burning in the photographs cannot be hydrogen. However, black-and-white photographic film of the era had a different light sensitivity spectrum than the human eye, and was sensitive farther out into the infrared and ultraviolet region than the human eye. And while hydrogen tends to burn invisibly, the materials around it, if combustible, would change the color of the fire.

The motion picture films show the fire spreading downward along the skin of the airship. While fires

generally tend to burn upward, especially including hydrogen fires, the enormous radiant heat from the blaze would have quickly spread fire over the entire surface of the airship, thus apparently explaining the downward propagation of the flames. Falling, burning debris would also appear as downward streaks of fire.

One note is that in 1935 a helium filled blimp with an acetate aluminium skin burned near Point Sur in California with equal ferocity.[31] Even the USS Macon, a U.S. Navy airship, burned after crashing into the Pacific off Monterey Bay. Those who disagree with these claims insist these two incidents had nothing to do with the dope, instead the small blimp burned because of a fuel leak, and the Macon burned because it was firing flares.

Those skeptical of the incendiary paint theory cite recent technical papers which claim that even if the airship had been coated with actual rocket fuel, it would have taken many hours to burn — not the 32 to 37 seconds that it actually took.[32]

Modern experiments that recreated the fabric and coating materials of the *Hindenburg* seem to discredit the incendiary fabric theory.[33] They conclude that it would have taken about 40 hours for the *Hindenburg* to burn if the fire had been driven by combustible fabric. Two additional scientific papers also strongly reject the fabric theory.[32]

However these claims do not agree with the results the Mythbusters achieved on their Hindenburg special of their TV show and others feel the criticisms does not take into account the conditions that lead to firestorms, such as convection and ignition from radiant energy.

The most conclusive proof against the fabric theory is in the photographs of the actual accident as well as the many airships which were not doped with aluminum powder and still exploded violently. When a single gas cell explodes, it creates a shock wave and heat. The shock wave tends to rip nearby bags which then explode themselves. In the case of the Ahlhorn disaster on January 5, 1918, explosions of airships in one hangar caused the explosions of others in three adjoining hangars, wiping out all five Zeppelins at the base.

The photos of the *Hindenburg* disaster clearly show that after the cells in the aft section of the airship exploded and the combustion products were vented out the top of the airship, the fabric on the rear section was still largely intact, and air pressure from the outside was acting upon it, caving the sides of the airship inward due to the reduction of pressure caused by the venting of combustion gases out the top.

The loss of lift at the rear caused the airship to nose up suddenly and the back to break in half (the airship was still in one piece), at that time the primary mode for the fire to spread was along the axial gangway which acted as a chimney, conducting fire which burst out the nose as the airship's tail touched the ground, and as seen in one of the most famous pictures of the disaster.

Television investigations

As mentioned previously, the Discovery Channel series *MythBusters* explored the incendiary paint theory (IPT) and the hydrogen theory in an episode that aired January 10, 2007.[34] While their experiments didn't concern what actually started the fire, the show's hosts, Adam Savage and Jamie Hyneman, demonstrated that when set alight with a blowtorch a 1:50 scale model of the *Hindenburg* burnt twice as fast in the presence of diffused hydrogen as without it. Combustion was observed in the burning skin, which would have accelerated the fire, but their experiments showed that hydrogen was the main fuel. The hydrogen filled model produced a fire with flames that came out of the nose and resembled the newsreel footage of the *Hindenburg* disaster. That program concluded that the IPT myth was "Busted".

The *MythBusters* constructed three 1/50 scale models made out of welded steel wire and covered in cotton fabric. They were suspended from a hangar ceiling and stayed horizontal the entire time. The first model was painted with iron-oxide and then aluminum powder dopes, closely replicating the actual skin of the *Hindenburg*. Ignited with a blowtorch, it took about 2 minutes to burn, with thermite-like events (sparkling blazes) noted in a few places. The second model had the same skin, but a water trough inside diffused hydrogen gas at sub-explosive concentrations. This one burned about twice as fast, with more thermite burning. The third model, done more for spectacle than anything else, had the skin painted with a thermite-like iron-oxide and aluminum powder enriched dope. It was noted that it would probably be far too heavy to fly. With model 2's hydrogen enrichment, it took 30 seconds to completely consume the skin. The conclusion was that neither the hydrogen gas nor the flammable skin bore sole responsibility for the speed of the fire, but both contributed.

The National Geographic program *Seconds From Disaster* had veteran air crash investigator Greg Feith study all of the available evidence, including eyewitness accounts, interviews with the last two living survivors, newsreel footage, weather reports, and the *Hindenburg* blueprints. Feith burned a sample of doped cloth and it took one minute to consume the whole piece, ruling out the skin as the primary accelerant. Feith's investigation came to a conclusion that the hydrogen puncture theory was most probable. He also proved that by adding white cloth to a hydrogen flame that it would change the fire's color from

invisible to orange.

In Search of..., a show mainly focused on paranormal investigations and conspiracy theories, made an episode based on this tragic accident, and immediately raised the question of whether it was really an accident or instead sabotage by then-Nazi Germany.

Memorial

The actual site of the Hindenburg crash at Lakehurst Naval Air Station (reestablished as Naval Air Systems Command (NAVAIR) at Naval Air Engineering Station (NAES) Lakehurst, or "Navy Lakehurst" for short[35]) is marked with a chain outlined pad and bronze plaque where the airship's gondola landed.[36] It was dedicated on May 6, 1987, the 50th anniversary of the disaster.[37] Hangar #1, which still stands, is where the airship was to be housed after landing. It was designated a Registered National Historic Landmark in 1968.[38] Pre-registered tours are held through the Navy Lakehurst Historical Society.[39] Due to security concerns, no foreign nationals are permitted on the tours.[37]

Current marker at the disaster site, shown with Hangar #1 in background

References in Media and Popular Culture

Television

In season 2, episode 11 of *Beyond Belief: Fact or Fiction*, the twist at the end of 'Bon Voyage' reveals that the story has been taking place on the Hindenburg moments before the crash.

The Hindenburg disaster is chronicled in the popular 1970's television program, "The Waltons" where "John Boy Walton" wins a writing contest to cover the landing of the Hindenburg, witnessing the unforseen tragedy up close and in person.

Music

The cover of Led Zeppelin's self-titled debut album shows a stylized photo of the Hindenburg disaster with the band's name in the upper left corner.

See also

- LZ 129 Hindenburg
- Crash cover
- *Hindenburg Disaster Newsreel Footage*
- Hindenburg Omen
- Herbert Morrison (announcer)
- List of airship accidents
- *Hindenburg: The Untold Story* was a docudrama aired on the 70th anniversary of the disaster, May 6, 2007.
- Timeline of hydrogen technologies

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Notes

1. **^** "Souls on board" is an aviation and maritime term designating the total number of living persons comprising the passengers and crew aboard an aircraft in flight or a vessel at sea.
2. **^** Per an annotated ship's diagram submitted to the U.S. Commerce Department's Board of Inquiry into the disaser, there were 12 men in the forward section of the ship at the time of the fire: Ludwig Felber (apprentice "elevatorman"); Alfred Bernhardt (helmsman); Erich Spehl (rigger); Ernst Huchel (senior elevatorman); Rudi Bialas (engine mechanic); Alfred Stöckle (engine mechanic); Fritz Flackus (cook's assistant); Richard Müller (cook's assistant); Ludwig Knorr (chief rigger); Josef Leibrecht (electrician); Kurt Bauer (elevatorman); and Alfred Grözinger (cook). Of these, only Leibrecht, Bauer, and Grözinger survived the fire. Examination of the unedited Board of Inquiry testimony transcripts (stored at the National Archives,) combined with examination of the Landing Stations chart on page 212 of Harold Dick and Douglas Robinson's book "Graf Zeppelin and Hindenburg," indicates that the six off-watch men who were sent forward to trim the ship were Bialas, Stöckle, Flackus, Müller, Leibrecht and Grözinger. The other men were at their previously assigned landing stations.
3. **^** Blimps, dirigibles and Zeppelins are categorized as "airships." Airplanes and helicopters are categorized as "winged aircraft." The term aerostat is reserved for balloons.
4. **^** This is corroborated by the official testimonies and later recollections of several passenger survivors from the starboard passenger deck, including Nelson Morris, Leonhard Adelt and his wife Gertrud, Hans-Hugo Witt, Rolf

von Heidenstam, and George Hirschfeld.
5. ^ Board of Inquiry testimony of Hans-Hugo Witt, a Luftwaffe military observer traveling as a passenger.
6. ^ Subsequent on-camera interviews with Späh and his letter to the Board of Inquiry corroborate this version of his escape. One or two more dramatic versions of his escape have appeared over the years, neither of which are supported by the newsreels of the crash, one of which shows a fairly close view of the portside passenger windows as passengers and stewards begin to drop through them.
7. ^ Although Joseph Späh survived the Hindenburg accident and fire, ironically he was not as "lucky" when he appeared in the 1976 motion picture Marathon Man. Billed in the film under his longtime stage name, Ben Dova, Späh portrayed the brother of fugitive Nazi war criminal Dr. Christian Szell (Laurence Olivier). Ironically Späh's character is involved in an automobile accident early in the film in which his car collides with an oil delivery truck and he is burned to death in the ensuing fire.[6]
8. ^ Board of Inquiry testimonies of Kurt Bauer and Alfred Grözinger

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3. ^ ***a*** ***b*** ***c*** Blackwell 2007, p. 311.
4. ^ Hoffmann and Harkin 2002, p. 235.
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External links

Video

- Actual film footage of Hindenburg disaster (http://www.britishpathe.com/record.php?id=50144)
- Footage from Castle and Pathé coverage of the Hindenburg disaster at (http://www.archive.org/details/hindenberg_explodes) Internet Archive
- YouTube video: Universal Newsreel - May 10, 1937 Special report on the *Hindenburg* disaster. (http://www.youtube.com/watch?v=8V5KXgFLia4)
- YouTube video of Herb Morrison's famous report synchronized with newsreel footage (http://www.youtube.com/watch?v=F54rqDh2mWA)

Articles and reports

- Hindenburg disaster (http://www.timesonline.co.uk/tol/system/topicRoot/Hindenburg_disaster_/) — Original reports from *The Times* (London)
- The Hindenburg Makes Her Last Standing at Lakehurst (http://books.google.com/books?id=xkQEAAAAMBAJ&pg=PA26&dq=Hindenburg+life+magazine+1937&cd=6#v=onepage&q&f=false) — *Life* Magazine article from 1937
- The Hindenburg Disaster (http://vault.fbi.gov/Hindenburg) — Report of the FBI investigation

Websites

- The Hindenburg Disaster (http://www.life.com/image/first/in-gallery/26252/the-hindenburg-disaster) - slideshow by *Life magazine*
- Rocket Fuel, Thermite, and Hydrogen: Myths about the Hindenburg Crash (http://www.airships.net/hindenburg/disaster/myths)
- Airships.net: Discussion of Hindenburg Crash (http://www.airships.net/hindenburg/disaster)
- "Hindenburg & Hydrogen" (http://www.abc.net.au/science/k2/moments/s1052864.htm) by Dr. Karl Kruszelnicki
- The Hindenburg and Hydrogen: Nonsense from Dr. Karl Kruszelnicki (http://www.airships.net/blog/dr-karl-hydrogen-hindenburg)
- *Thirty-Two Seconds* (http://www.keepgoing.org/issue20_giant/thirtytwo_seconds.html) - Article that features rare photos of the disaster, a photograph of the surviving crew and a report on Cabin Boy Werner Franz
- "What Happened to the Hindenburg?" Transcript: *Secrets of the Dead* (June 15, 2001, PBS) (http://www.pbs.org/wnet/secrets/previous_seasons/flash/hindenburg_script.html)
- Passenger and Crew List of the *Hindenburg* on its final voyage (http://www.nlhs.com/passenger-list.htm)
- Faces of the Hindenburg: Biographies and photographs of the survivors and victims of the final voyage (http://facesofthehindenburg.blogspot.com/)

Flammable fabric disaster theory

- An Article Supporting the Flammable Fabric Theory. (http://web.archive.org/web/20040619150217/http://www.dwv-info.de/pm/hindbg/hbe.htm) Retrieved with the Wayback Machine
- Two Articles Rejecting the Flammable Fabric Theory (http://spot.colorado.edu/~dziadeck/zf/LZ129fire.htm)
- Experiments Reject the Flammable Fabric Theory (http://www.sas.org/tcs/weeklyIssues/2004-12-17/project1/index.html)
- An article supporting the engine exhaust spark theory. (http://web.archive.org/web/20070929134810/http://www.philly.com/philly/opinion/20070506_The_real_cause_of_the_Hindenburg_disaster_.html) Retrieved with the Wayback Machine

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Categories: LZ 129 Hindenburg | Aviation accidents and incidents in 1937 | In-flight airliner explosions | Engineering failures | Filmed accidental deaths | Fires in New Jersey | History of the United States (1918–1945) | Aviation accidents and incidents in New Jersey | Ocean County, New Jersey | 1937 in the United States | 1937 in Germany